VOL XIII Nº 5 MAY 1928

MECCANO MAGAZINE



THE NEW HUDSON RIVER BRIDGE
(See page 370)

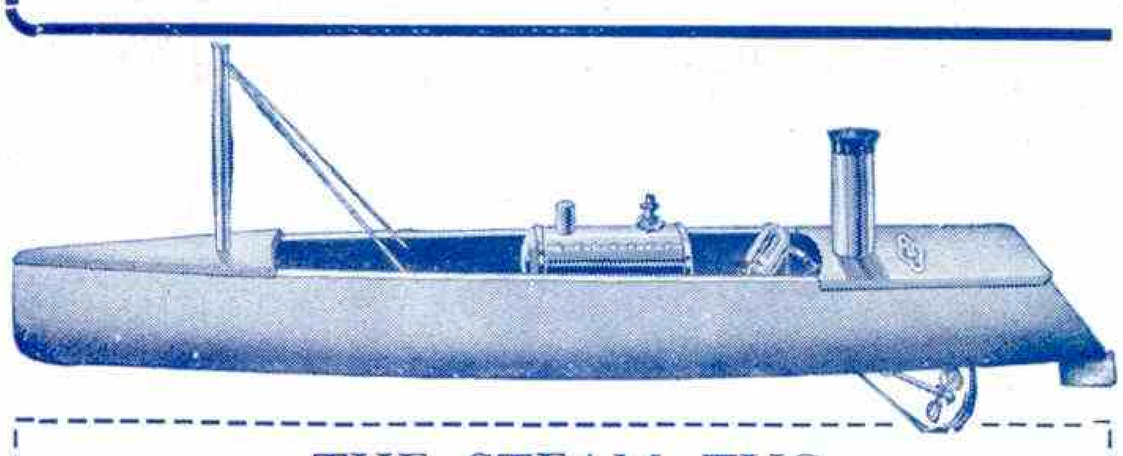
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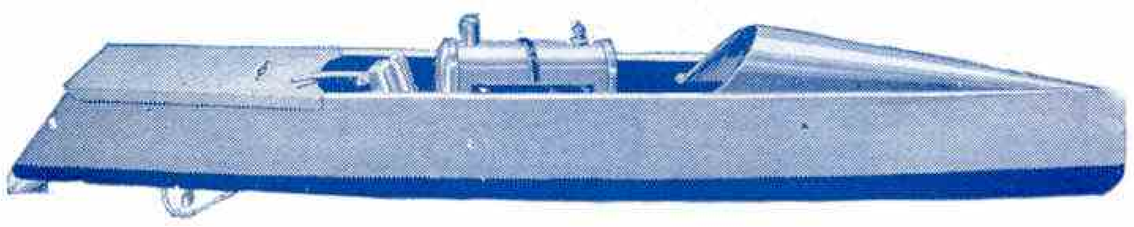


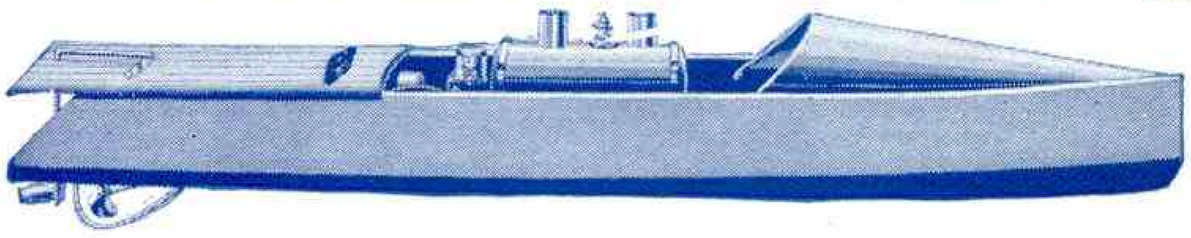
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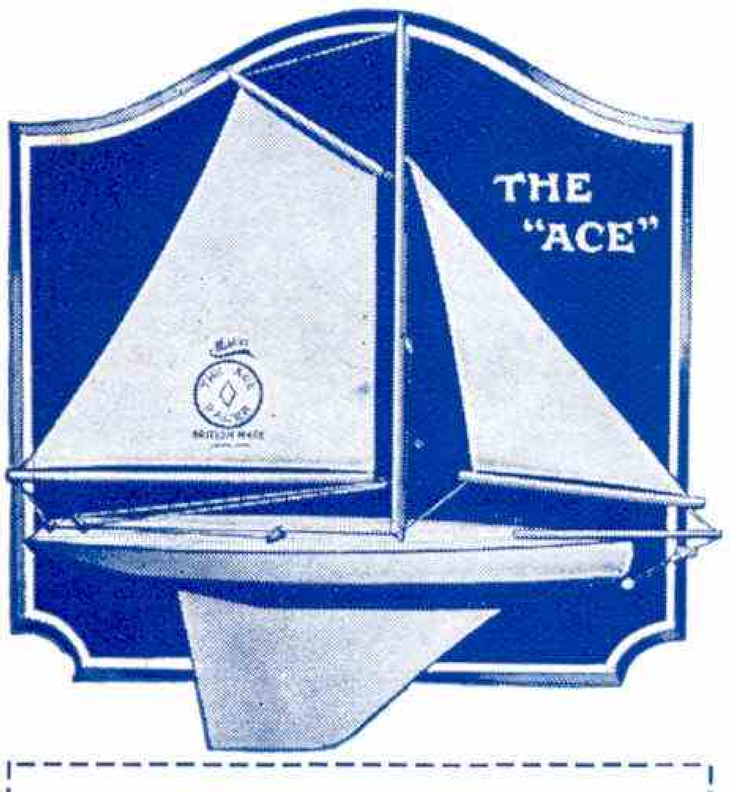
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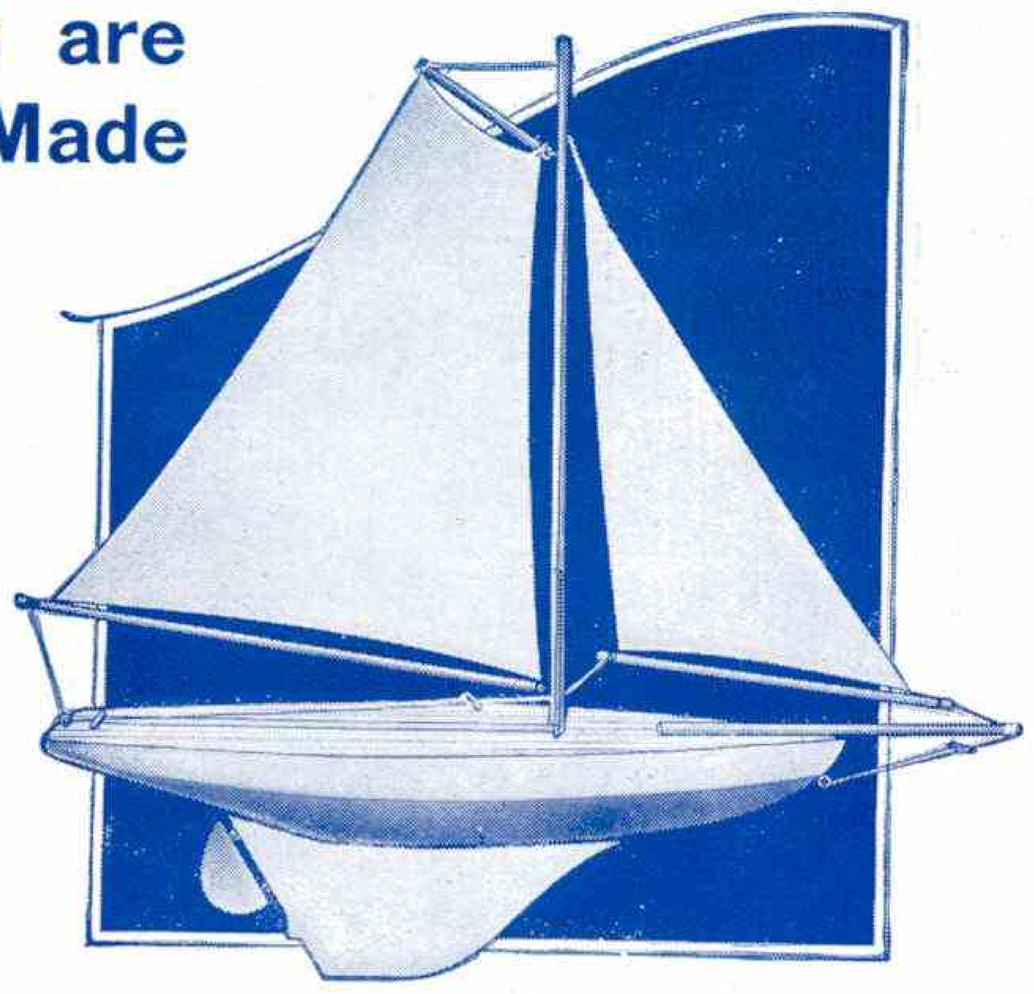
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With the Editor

The Habit of Success

When people are discussing the achievements of some particularly successful man, someone is sure to remark "He *has* been lucky." It is true that the careers of some successful men do appear to have been greatly influenced by luck or good fortune, but no man has ever yet succeeded in accomplishing anything great by luck alone. Success or failure is really to a great extent a matter of habit.

If, whenever we are confronted with a big task, we say to ourselves: "I do not think I shall be able to do it," we are starting the task in the wrong frame of mind. We are thinking about failure before we have attempted anything, and with this idea of failure in our mind it is very likely that we will fail to some extent. After a time this thought of failure becomes firmly impressed on the mind, self-confidence is lost and the habit of failure is formed. On the other hand, the habit of success is cultivated by approaching every task in a spirit of quiet self-confidence, saying to ourselves "This *can* be done, and I am going to do it." In this way we bring into play our very best bodily and mental powers.

The boy who starts to build a complicated Meccano model, and having half-finished it gives up the attempt on account of some difficulty that arises, has not only failed to build the model but has also lost a certain amount of mental strength. His mind has admitted defeat by the difficulty, and he is therefore so much weaker. Instead, if when a difficulty arises in building a model we determine to overcome it, saying "This model has been built by other boys and I am going to build it," we not only succeed in completing the model but we also gain more mental power and more self-confidence. We have won a victory, and each victory makes it easier for us to tackle the next difficulty that comes along.

Life is largely a succession of difficulties and obstacles and it is the overcoming of these that forms our character. Without difficulties and hardships life would be dreadfully monotonous, and by taking them in the right spirit we gain experience and courage enabling us to pass on to encounter even greater obstacles, the overcoming of which makes life worth while.

The "Blue Riband" of the Atlantic

Last year a French steamship company placed a new 42,000-ton liner on the Trans-Atlantic service and the famous Norddeutscher Lloyd gave orders for two 46,000-ton vessels of great speed for their service between Bremerhaven and New York. This seems to be the first step towards the revival of the old rivalry for the "blue riband" of the Atlantic.

Neither of the new vessels approaches the "*Majestic*" or the "*Berengaria*" in size but they will be as large as the largest liners ever built in Britain. Their speed, however, may be greater even than that of the wonderful "*Mauretania,*" the famous Cunarder that has held the Atlantic record for more than 20 years, for their engines are designed to develop no less than 90,000 s.h.p. The "*Majestic*" was constructed by one of the two firms engaged in building the new liners and an interesting comparison is possible. The 56,000 tons of the "*Majestic*" may be propelled at a rate of 25 knots by her engines of 66,000 s.h.p. It is almost certain, therefore, that 27 to 28 knots will be attained by the smaller Norddeutscher Lloyd boats in view of the much greater power of their engines.

The "*Mauretania*" has logged 27 knots, but she is growing older. When the German liners appear in two years' time there is every possibility that the proud distinction of being the world's fastest liners will be captured by them, unless the British steamship companies accept the challenge and embark on an ambitious building programme. Of late years these companies have shown a tendency to build vessels of round about 20,000 tons and of moderate speed, as they have proved more economical under the conditions that have obtained since the war than the better known giants.

Both the Cunard and the White Star lines are known to have new vessels under consideration and as our naval architects and engineers are capable of producing ships at least equal to any that may be produced elsewhere, it is to be hoped that the new vessels will form an adequate reply, not only to the challenge of our German competitors, but also to that of the Americans, who are now reported to be contemplating a fleet of boats with sufficient speed to make the Atlantic crossing in four days.

From the information available it appears that this will be the case, as it is understood that the new Cunarder will be a 60,000-ton ship at least 1,000 ft. in length, and will provide accommodation for 5,000 people. Details of the proposed White Star liner have not yet been revealed, but this also is expected to be a larger and faster vessel than the "*Majestic.*" Needless to say, the cost of these monsters will be very great, amounting to something in the neighbourhood of £11,000,000 for the pair.

Rotor Towers for Ship Propulsion

The use of the Flettner rotor towers for ship propulsion has attracted a good deal of notice during the last two years. The method was tried first on the "*Buckau*" and later on the "*Barbara,*" both of which vessels have been described at some length in the pages of the "*M.M.*"

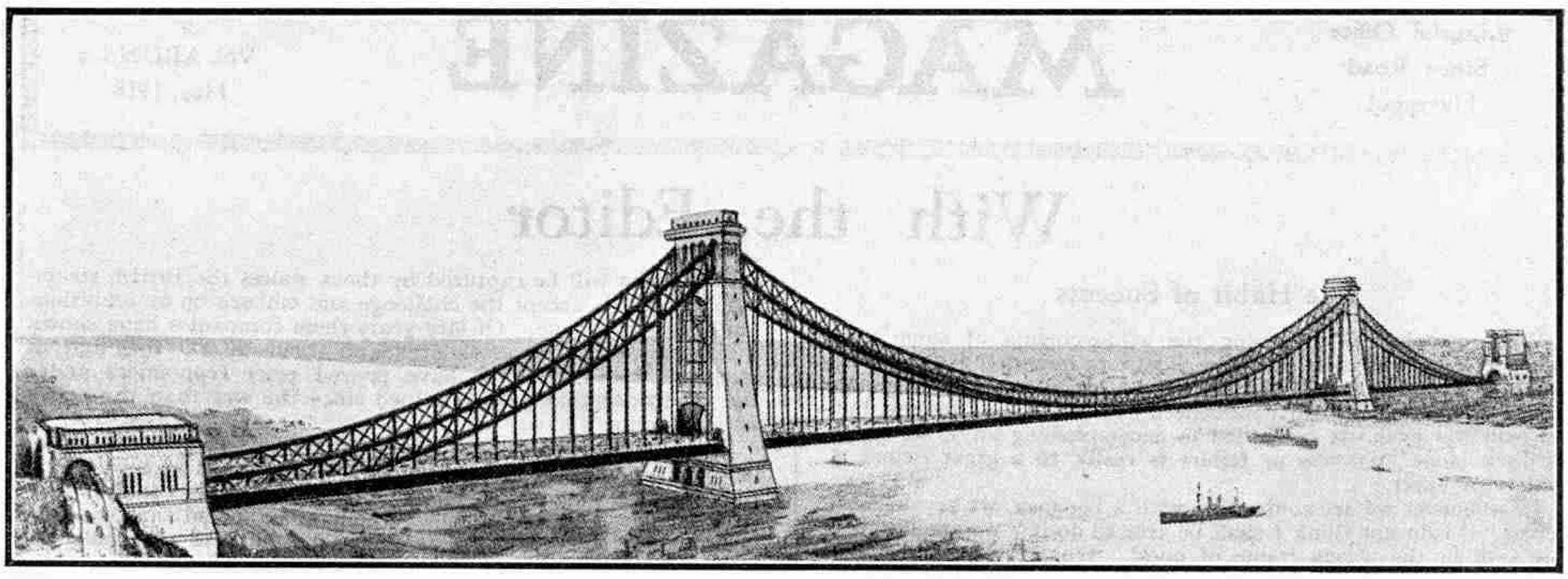
The experiences of the "*Barbara*" illustrate the many-sided nature of the problems that always arise in making practical applications of new principles. In this case it was not sufficient to establish the fact that rotor towers could propel a ship. It was also necessary to show that the addition of the towers would not endanger the stability of the vessel nor interfere with ease of handling, while important questions of cost of installation and maintenance had also to be considered. For the construction of the rotors a suitable metal or alloy had to be found that would be possessed of sufficient strength but at the same time would be of low density and not easily corroded by the salt spray to which it would be exposed.

To test as many of these points as possible the "*Barbara*" made several trips from Hamburg to Mediterranean ports. These were chosen instead of a trans-oceanic destination because they offered better opportunities of testing the manuœvring qualities of the ship, and as a result it may now be said that the Flettner rotor definitely promises to be invaluable as an auxiliary device. On the average rotors were in operation for a third of each voyage, and it seems that the most economical method of making use of them is to run them in conjunction with the screw propeller while the latter is operating at full speed. Used in this manner the rotors increased the speed of the "*Barbara*" from 9½ knots to 12 knots. On ordinary voyages this would lead to a considerable saving in time with, of course, an all-round reduction of expenses while at sea, the saving of a single hour on a voyage meaning a reduction in practically every expense connected with the running of the ship.

One essential and important fact that has emerged as a result of the trials is that, with the aid of the rotors, ten times as much power may be abstracted from the wind as is required to drive them.

The World's Greatest Suspension Bridge

Solving New York's Transport Problems



WITHIN the bounds of the city of New York are to be seen more great examples of the bridge-builder's art than exist anywhere else in the world in a region of equal size. The Municipality of New York controls no less than 44 bridges and three viaducts, while there are also in the city six bridges owned by railway companies.

It is not difficult to realise after a glance at the map why bridges should be such a prominent feature of New York. The central portion of the city is built on an island 22 square miles in area. Manhattan Island, as it is called, is a narrow rocky ridge two miles in width, cut off from the mainland on the north by the Harlem River and separated from New Jersey on the west by the Hudson River, nearly a mile in width. On the east is a large island called Long Island, the arm of the sea separating it from Manhattan Island being named the East River. On three sides, therefore, Manhattan Island is bounded by wide rivers, while the point, on which the famous skyscrapers are erected, juts out into the large expanse of water constituting New York harbour.

Great advances have been made in the art of building suspension bridges since 1819, when Telford was bold enough to build one with a span 550 ft. in length across the Menai Straits. Fifty years later a bridge with a suspended span of 1,595 ft. was erected between New York and Brooklyn, and even this was outdone by the bridge over the Delaware River at Philadelphia, completed in 1916, which has a span of 1,750 ft. in length.

The accompanying article describes a bridge now under construction across the Hudson River at New York, which from pier to pier will be twice the length of the Philadelphia giant.

The area available for expansion has been quite insufficient since the beginning, in the middle of last century, of the amazingly rapid growth of the city. Skyscrapers have been erected in business quarters to increase accommodation and buildings in general have been carried to a greater height than in most cities, but it has been impossible to avoid an overflow of population into New Jersey, Brooklyn on Long Island and the Bronx, as that part of the mainland across the Harlem River is called. This has brought the problem of communication and transport into prominence.

Until 1883 ferryboats provided the only means of transport across the rivers. In that year Brooklyn Bridge, or the " Great Bridge " as it was then called, was completed, giving direct access to Brooklyn. The erection of this bridge was both a romance and a tragedy. It was an engineering romance in the sense that the designer, J. A. Roebling, had to overcome the opposition of practically every engineer of prominence. He had already built several bridges of the suspension type in which giant wire ropes were used to support the load, but when he suggested such a bridge for spanning the East River, failure and disaster were prophesied on all sides. He himself never lost confidence and the completion of the bridge completely justified him.

The tragedy was the death of Roebling. When returning from an inspection of the site of one of the piers, the docking of the boat in which he crossed the river was bungled, with the result that one of his feet was crushed against the quay-side. The comparatively slight accident gave rise to serious complications and Roebling was soon unable to leave his room. Still determined to see his design carried to a successful conclusion, he took rooms overlooking the bridge so that he could watch progress through the windows, but unfortunately he died before the bridge was finished.

The volume of traffic across the rivers, particularly across the East River, increased at such a rapid pace that the ferry services could not cope with it in spite of the relief afforded by Brooklyn Bridge, and eventually it became necessary to construct other bridges at various places along the river.

Within a short distance of the site of Roebling's bridge two huge structures known respectively as the Williamsburg and Manhattan Bridges were erected. These also were suspension bridges of the same type as the first East River Bridge. Roebling's structure has a central span of 1,595 ft. and a total length of 6,016 ft. It is surpassed by the great Williamsburg Bridge, which is practically 1,300 ft. longer and has a single span of no less than 1,600 ft., while the Manhattan Bridge is almost as large.

By the time that these great bridges were opened for traffic others equally interesting were in course of construction higher up the East River and also across the Harlem River. One of these was the Queensboro Bridge, a splendid cantilever structure with three spans, 1,182 ft., 984 ft. and 630 ft. in length respectively, and a total length of 7,449 ft. The two intermediate piers of this bridge rest on an island which is crossed by the shortest of the three spans. It carries four railway tracks, four car tracks, two footwalks and a roadway, and because of the heavy load it is intended to carry it contains steel parts much heavier and stronger than are to be found in any bridge previously built.

One peculiarity of the Queensboro Bridge is that the cantilever arms project so far that they meet without any intervening suspended span of the type seen so clearly in the case of the Quebec and Forth Bridges. This is unusual and it is scarcely likely that any other large cantilever bridge will be built in this manner.

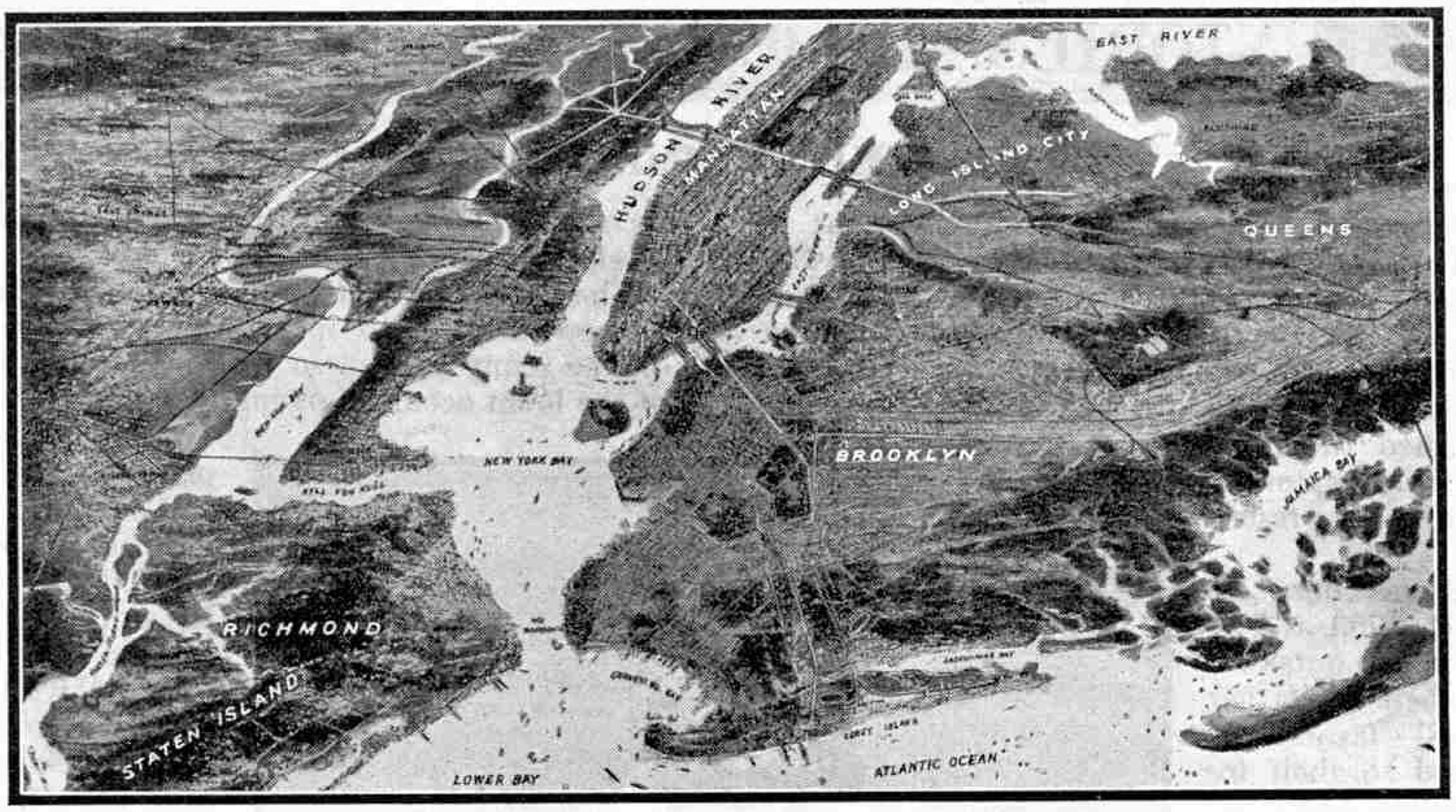
The remaining bridges built across the Harlem and East Rivers are chiefly of value for railroad transport to the mainland, especially to the eastern states. The Hell Gate Bridge, for instance, was built by two railroad companies to connect the line from the New England States with the Brooklyn tracks and those by tunnel with the Manhattan terminal. The chief features of this bridge

are its great length of 18,130 ft. and a great arch across one branch of the river that has a span of 977 ft. Its surprising length is due to the fact that it is really a series of bridges spanning the East River by way of two large islands.

From Hell Gate Bridge down the East River to Brooklyn Bridge is a distance of 7½ miles. A boat making the journey from one bridge to the other would pass in succession under the Queensboro, Williamsburg and Manhattan Bridges, and thus five of the nine largest bridges in the world are to be seen in this short distance. The presence of these bridges alone is sufficient to justify the description of New York as the "City of Bridges."

Another interesting point is that the combined length of the five bridges—including that of the approaches and portions crossing islands—is 8½ miles, and is thus actually greater than the length of the stretch of river over which they have been built!

Bridges now building or planned will make New York even more remarkable than it is now. The mouth of the harbour is almost closed by Staten Island, a large tract of land off the New Jersey shore, and bridges are projected to cross the various channels between the island and different parts of the mainland.



Our illustration shows a bird's-eye view of the bridges of New York. The new bridge across the Hudson River is seen across the centre of the river towards the top

These will be magnificent structures. Two of them are to be cantilever bridges with centre spans of 672 and 750 ft. respectively, while the third will be an arch bridge similar in many ways to the Sydney Harbour Bridge now under construction. The span of the arch of this bridge will be 1,650 ft. and will thus be equal in size to that of the Australian bridge. The appearance of all three will be rendered more imposing by a feature common to all the bridges so far mentioned—that is their great height. The waterways around New York are traversed by large ocean-going ships and great height is necessary in order to give the vessels room. On the average the height of the roadways at the centres of the bridges is 140 ft. above high-water level.

A still more remarkable bridge is now being erected. Towards the end of September, last year, preliminary operations were commenced on a suspension bridge across the Hudson River which, when it is completed in 1932, will be the biggest of its type in the world. This great bridge is being built to relieve traffic congestion by providing increased transit facilities between the northern part of Manhattan Island, the Bronx, Long Island, and New Jersey.

The need of a bridge over the Hudson River at New York was not felt very greatly before the time of railroads, for the ferry boats plying from one shore to the other were sufficiently large and numerous to meet the demands for both passengers and freight. By degrees, however, as traffic increased on the great trans-continental railways—all but one starting from the west side of the Hudson River—a demand for a more rapid crossing of the river sprang up.

This led, in 1878, to an attempt to tunnel the river, but operations were interrupted time after time and no progress was made until some 30 years later. Tunnels under the river for steam locomotives with their accompaniment of unpleasant fumes were not considered desirable, and in 1887 the Pennsylvania Railroad began to consider the idea of spanning the river with a bridge. The first serious investigations for bridging the river were carried out for this railway by Samuel Rea and Gustav Lindenthal, who came to the conclusion that a bridge was quite feasible but that it would be necessary for it to have a single span over the entire river.

The United States Government would not permit any bridge piers between pierhead lines; it had to be either tunnels or a single span bridge. The Hudson River is more than twice as wide as the East River, and the idea of a single span double the length of the great Brooklyn Bridge, the longest span then in existence, appeared to many engineers to be impracticable. As the science of bridge construction advanced, however, it became evident that Lindenthal's plans made in 1887 for a single span bridge were quite practicable, and the project assumed concrete form.

A Charter was duly obtained by the North River Bridge Company. Plans were submitted to the War Department and permission was given for the construction of the bridge. Work began, and it promptly led the company into litigation in connection with the condemnation of land for the necessary right of way. The legal war was carried up to the Supreme Court, which gave a decision upholding the powers of the bridge company to condemn property required for its structures. The way for the immediate building of the bridge now seemed to be clear, but in 1893 occurred a financial panic which resulted in the bankruptcy of all but two of the railway companies on the New Jersey side. Recovery occupied some six or eight years, during which time electrical traction made such progress that it came into prominence as an ideal means of transportation through tunnels.

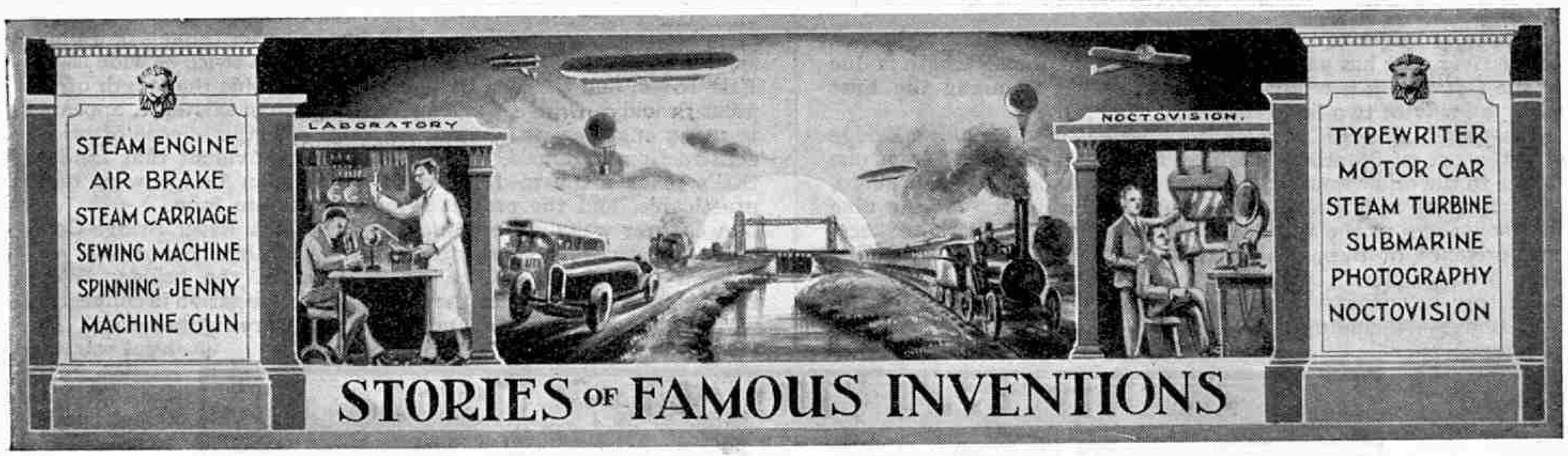
The Pennsylvania Railroad was ready to take the lead in the construction of the bridge, but being then unable to obtain the support of the other railways it decided not to wait any longer but to obtain an entrance into Manhattan and Long Island through two tunnels under the Hudson River, under Manhattan, and four tunnels under the East River. This naturally was a setback for the bridge scheme, but then the motor car made its appearance in such numbers and with such efficiency as to create a new and strenuous demand for a bridge crossing the river independent of the railroads. Ultimately it became obvious that the ferry and tunnel services would not be sufficient to meet present conditions, to say nothing of the future, and the construction of a new bridge became inevitable.

The suspension bridge probably owes its ancestry to primitive structures of twisted stems of creeping plants or of ropes used by the natives of tropical countries, and even to-day simple bridges of this type are being erected by the natives of certain parts of Africa, South America and elsewhere. The modern type of suspension bridge with a level roadway came into use in England and America about the end of the 18th century.

The advantages of a suspension bridge are numerous from the point of view of the builder. Every part of the bridge is in tension, and additional strengthening as a precaution against bending, such as is necessary with long girder bridges, is not required. Further, the wire cables offer an exceedingly high resistance to tension by reason of the great tensile resistance of the outer skin of the wire. On a suspension bridge the strain is least in the centre of the span, and here the weight of the bridge per unit of length is also reduced to a minimum. The weight increases towards the bridge towers or piers from which the overhead cables hang, by reason of the gradual upward trend of the latter and the increased length of the suspending rods.

The principal disadvantage of the suspension bridge lies in its lack of rigidity, and in almost all modern large span suspension bridges the structure is steadied with horizontal stiffening girders, which also serve to prevent distortion. The first large suspension bridge to be stiffened in this manner was one built across the River Thames at Battersea, in 1862.

(*Continued on page* 401)



III.—THE SPINNING MULE

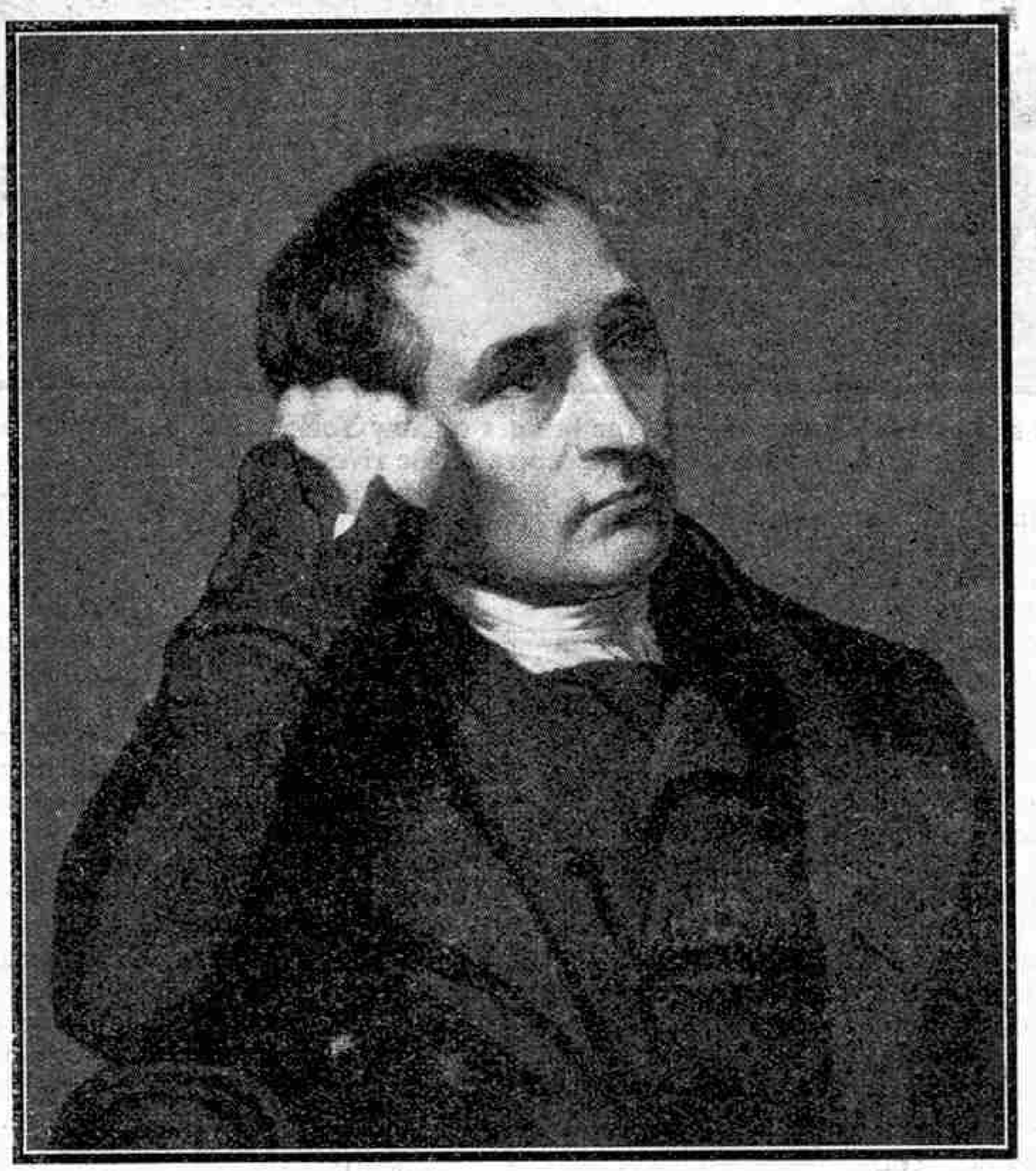
THE inventions of Hargreaves and Arkwright as described in the last two issues of the *"M.M."* provided two improved methods of producing cotton yarn, but a great deal still remained to be done. It was left to Samuel Crompton to produce a machine that not only remedied the defects of its predecessors but also formed the basis of the wonderful spinning machinery of the present day.

Crompton was born on 3rd December, 1753, at Firwood Fold on the outskirts of Bolton, where his father had a small farm. His parents added to their income by carding and spinning cotton thread and weaving calico during the evenings. When the boy was five years old his father was appointed caretaker of a large untenanted mansion standing in the middle of well-wooded grounds and known as "Hall i' the Woods." The farm was then relinquished and the family went to live in a portion of the big gloomy house. Shortly afterward disaster overtook them in the shape of the death of the father.

The widow was a strong-minded woman and she immediately set herself to bring up the boy on strict lines. When he was eight or nine years of age she taught him to spin cotton yarn in readiness for weaving on the hand looms. He was given a certain amount of spinning to do each day, and was not allowed to go to bed at night until that task was finished. At the age of 12 he was placed with some skilled weavers for a year in order to learn the art of cotton weaving, in which he made rapid progress.

Even during this strenuous period of work the boy found time to construct for himself a violin with the aid of a set of organ building tools that had belonged to his father. Having duly completed his instrument he then taught himself to play it, and became so proficient that subsequently he obtained an engagement in the orchestra of a Bolton theatre at the modest salary of eighteenpence per night.

The hand looms of that period were simple structures and not difficult to operate, but the cotton yarns spun on the jenny proved so fragile that frequent stoppages of the loom occurred owing to the breaking of the yarn. Crompton was deeply impressed with this defect and began to devote a great deal of thought to the possibility of remedying it. In a quaintly spelled and worded account of his life that he wrote in 1807 to the President of the Royal Society he recalled his early difficulties as a weaver as follows. The words in brackets are not in the original but are inserted to make the meaning clear:—



Samuel Crompton

"I then wove 5/4 Marsailes Quiltings the warp of which was all of Jenny spun yarn. of which yarn when in the Loom and if i could find one good thread of a yard long there was ten bad ones and being grieved at this i reasoned thus in my own mind if one thread can be good why not all good, this question (I) often asked my own mind, to which i never could give any Satisfactory (answer) to the Query . . . having full experience of all the process of preparing and Spining on the Jenny—as well as on the Single Spindle—i became inflamed with a strong intense desire to rectifie the evils of our then process of preparing and Spining of Cotton not a Soul on earth knowing of my intention neither was there one in whom (I) could hope to find any help from . . ."

In 1774 Crompton fitted up an upper room in the old house as a workshop and equipped it with tools and materials purchased with such money as he could save out of his small earnings. There he commenced his experiments and for three years he laboured incessantly to invent a machine that could spin "every thread of Cotton yarn. . . . Eaqually good." At last he believed that he had evolved a machine capable of

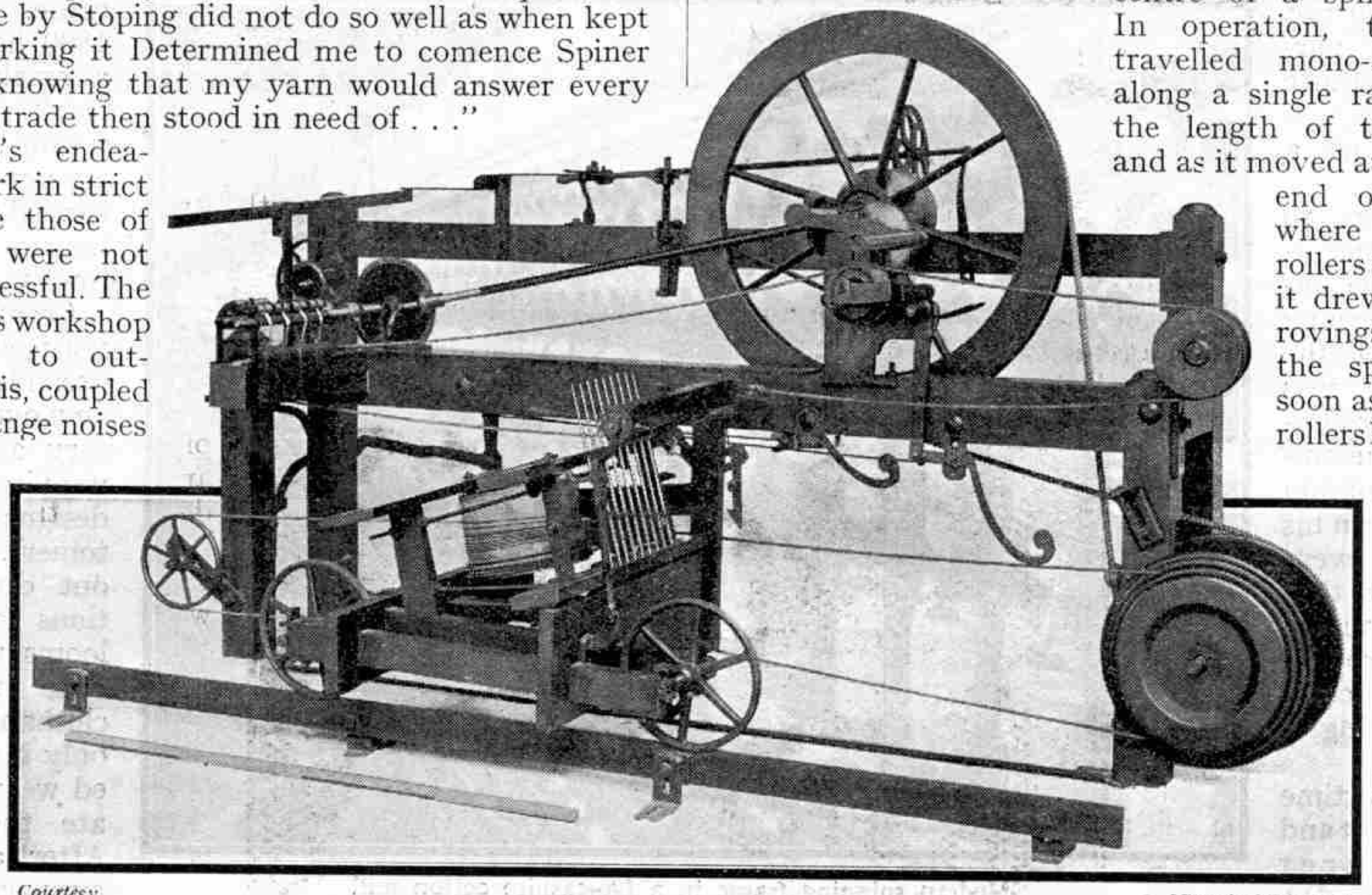
accomplishing his purpose. "After this," he relates in his biographical letter, "every Spare moment was Employed in makeing a maschine which was to be the Standard on which to rest all my future hopes both as to good yarn and profit to myself, which by Little & Little i finished in about 18 Months for my finances would not allow me to proceed Quicker with it and having finished it i began to Spin on it for my own Use both warp and weft which warp and weft Eaqualed my Highest Expectations—but finding by experience that when i Stoped Spining to weave What i had spun that my maschine by Stoping did not do so well as when kept constant working it Determined me to comence Spiner alltogether knowing that my yarn would answer every purpose the trade then stood in need of . . ."

Crompton's endeavours to work in strict secrecy, like those of Arkwright, were not entirely successful. The light from his workshop was visible to outsiders and this, coupled with the strange noises heard at various times to come from the room, gave rise to a local belief that the mansion was haunted. Later a rumour spread that Crompton worked far into the night with "wires and wood" and the haunted house idea gave place to the belief that he was a conjuror practising his profession! For a time this belief served to keep him free from molestation, but after a while some person of more intelligence expressed the opinion that the "conjuror" was really designing a machine that should spin cotton more swiftly than man or any previous machine had been able to do.

Crompton was well aware of the antagonism of the Lancashire weavers towards spinning machinery, and of the rough treatment that Hargreaves and Arkwright had received. As soon, therefore, as he found that the local weavers were beginning to regard him with suspicion, he set about to find some means of concealing his machine in the event of an attempt being made to raid his workshop. Finally he cut a hole in the ceiling of the room through which he could haul the partially dismantled machine into the room above. On one occasion at least he had recourse to this measure and the parts lay hidden in the room above for several weeks.

In spite of all difficulties and disturbances the machine was completed in due course, but by that time Crompton was so poor that he could not afford to patent his invention. He was therefore obliged to content himself by using it in his own home.

The machine embodied Arkwright's method of attenuating the cotton thread by passing it between "drawing" rollers, and incorporated Hargreaves' principle of rotative spindles without bobbins. The drawing rollers were mounted at one end of a long vertical frame and received the cotton thread from bobbins fixed upon a transverse horizontal bar called the "roller beam," immediately above. The rovings were passed from the rollers to individual spindles mounted in a row at the front of a movable carriage. These spindles were fixed in an inclined position and corresponded to the inclined spindles carried in the fixed rack across the centre of a spinning jenny. In operation, the carriage travelled mono-rail fashion along a single rail extending the length of the machine, and as it moved away from the end of the frame where the drawing rollers were situated it drew with it the rovings attached to the spindles. As soon as the drawing rollers had permitted the correct length of roving to pass between them they ceased revolving and held the threads securely, but the spindle carriage continued to move until it had attained its full length of travel, thus further drawing out the roving.



Courtesy [*Board of Education*

Model of the Spinning Mule invented by Crompton in 1779

When the carriage had completed its forward journey the direction of travel was reversed by hand and the carriage then moved back toward the roller beam. The rotation of the spindles as the carriage made this double journey twisted the threads during the outward run and wound them upon the spindles during the return trip. The carriage had a very even movement, travelling away from the rollers in a manner that imposed the minimum of strain upon the untwisted threads and aided in the production of yarn more smooth and even, and more finely spun, than that produced by any previous type of spinning machine.

A large flywheel operated by hand surmounted the frame of the spinning machine. This imparted rotative motion to the drawing rollers through bevel gearing, and actuated the spindle carriage by means of a rope drive. The simple arrangements of driving mechanism employed are shown clearly in the accompanying illustration of a model of the machine.

Crompton was now able to produce a much greater quantity of cotton yarn than hitherto, and the superior quality of his product enabled him to obtain a higher price for it. This quickly aroused the jealousy of the local weavers and in 1780 Crompton found himself becoming a very unpopular person. In the letter already quoted from he declares that: "At that time all the Obstacles which stood in the way of the most

extensive and lucrative cotton trade ever known in this country was the want of good Spining, which no sooner did it begun to be wove by Other weavers than myself than they were all Amasement saying, whence hath this man this yarn ? how is it produced ? it was Like a lighted Match to gunpowder or the Discarge of a high Charged Electrical Battery.—it spread in every direction and was sounded abroad far & near. the consequence was that i was teased from every Quarter Both publicly and privately. all the friends my little circle in life could afford me Stood agast affording not the smallest particle of assistance and every one Looking on me as a prodige. . ."

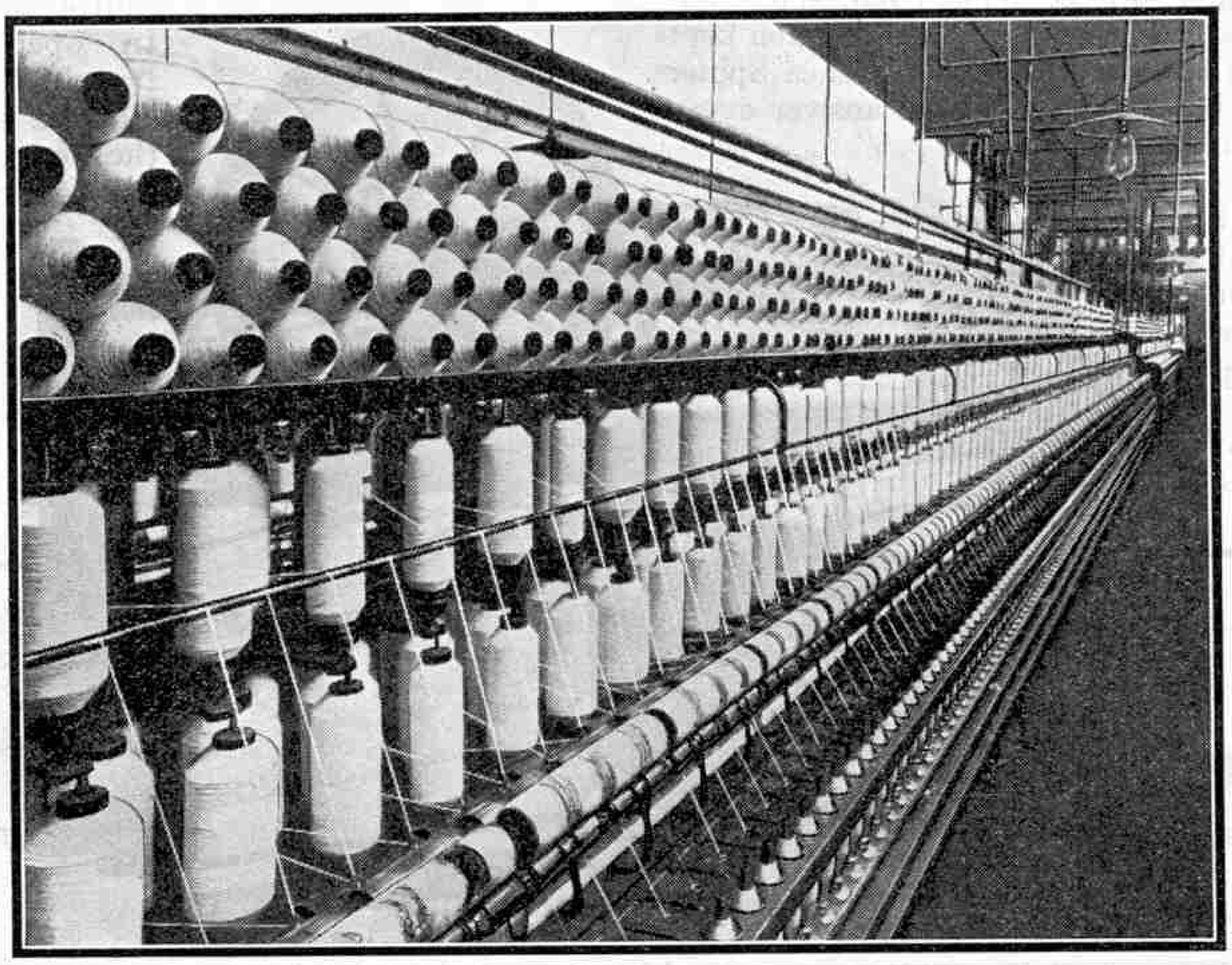
Spies began to gather about the inventor's house intent upon learning the nature of the machine he was using and Crompton relates the unpleasant situation so wrought upon his nerves that eventually he felt that he must end it either by destroying his machine completely or giving it to the public.

About this time a local merchant and manufacturer named John Pilkington greatly desired to know the secret of Crompton's machine, and in furtherance of this desire he persuaded 79 other cotton manufacturers to give their signatures to a written promise that each would pay Crompton one guinea if he would divulge to them the details of his machine. This document was duly prepared and presented to Crompton and was the means of inducing him to make public his invention. He gave away his secret in good faith, but the promised payments did not materialise, and he then discovered that the document upon which he had relied was legally worthless. All the money that he ever got from these unscrupulous manufacturers amounted to only £61 6s. 6d., and his requests for full payment were met with nothing but abuse.

Crompton's machine was regarded as a cross between Hargreaves' spinning jenny and Arkwright's spinning machine, and ultimately it became known as the Spinning Mule. The efficiency of the invention was quickly realised by the cotton manufacturers, and it soon became a familiar piece of machinery in many cotton mills. Great fortunes were made out of it by numerous people —but not by the inventor.

With the money he had received for disclosing the details of his machine Crompton rented a small farm and there continued spinning and weaving. He brooded a good deal over the shameful treatment he had received from those who had profited so richly from his invention, and it is said that during one particularly acute fit of bitterness he smashed up his own spinning mule and also a new carding machine that he had just perfected.

In 1790 Crompton removed to Bolton and there set up as an independent weaver. From 1794 to 1797 he utilised his spinning mule to manufacture rovings, which he sold to local spinners at the price of 4/– per pound. This proved a poor means of livelihood, however, and after a while he commenced to accept twist in part payment for his rovings. On this system of exchange he was able to acquire a spinning mule of 180 spindles and with the aid of this machine he appears to have materially increased his income, for about 1800 he established a small factory in Back King Street where he employed several weavers and carried on the manufacture of robes and frocks.

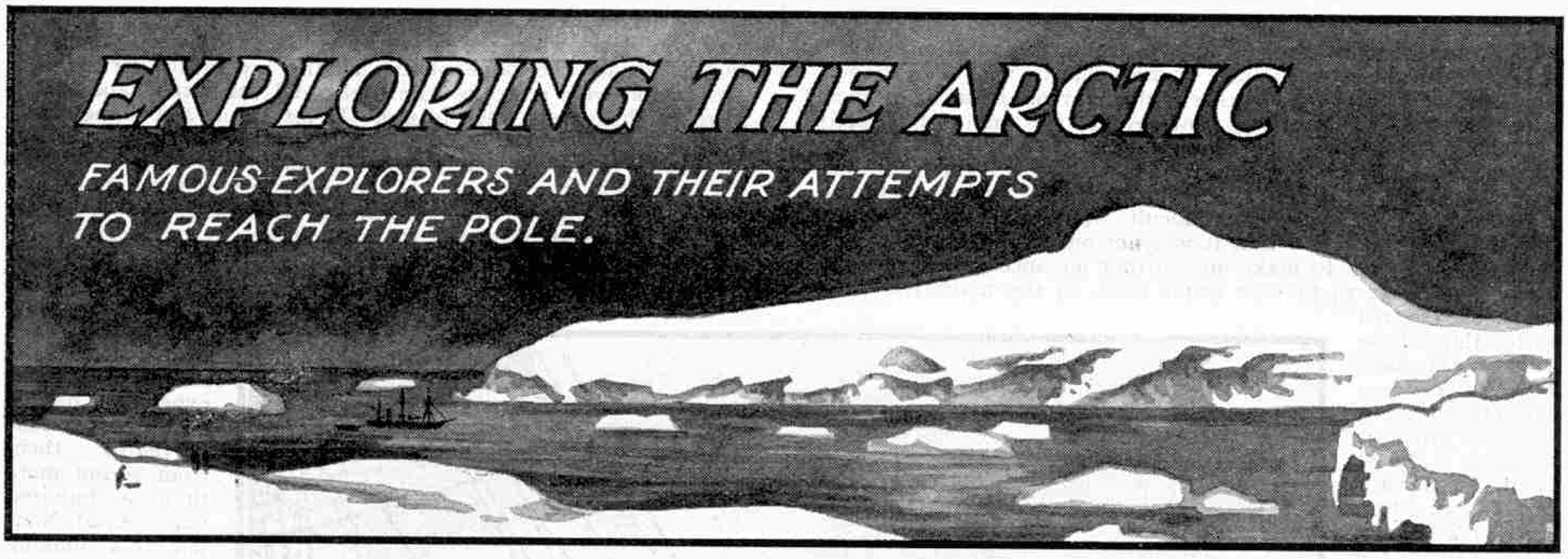


Modern spinning frame in a Lancashire cotton mill

Crompton became very successful in designing fabrics to be woven at his factory as well as in weaving fabrics to designs sent by customers. He carried out certain alterations to the twelve looms used to produce these fancy cloths and employed only his most trusted weavers to operate the machines. After a while the ever-watchful rival manufacturers learned that he was again engaged in secret developments and once more they strove to obtain details of the latest improvements. Crompton records that the manufacturers who were jealous of his successful weaving were so persistent that on some days as many as 30 or 40 people hung around his workshop, pestered his weavers, and sought " by every possible excuse and pretence to obtain a sight of the Loom and how it was worked."

The success of the spinning mule promoted such an extensive trade in muslins that certain people, who realised how badly Crompton had been treated, started a " conscience money " fund to compensate him, but the effort met with little response, only £444 being subscribed. In 1807 Crompton wrote to the President of the Royal Society inquiring as to what steps he should take to protect the minor improvements in weaving that he had brought about at his factory. This letter, from which we have already quoted, included an account of the inventor's arduous life, and it was written in the hope that the President might be moved to enlist the interest of " the King and his Ministers in council " in the matter. The letter does not appear to have achieved its purpose, however, for no Government grant was made to Crompton at the time.

Subsequently the Government made a grant of £10,000 to a man named Cartwright who had invented a successful power loom, and this stirred up Crompton to make a further effort to obtain recognition of his work. As a preliminary he commenced a tour (*Continued on page 442*)



XIX.—FARTHEST NORTH—NANSEN'S GREAT RECORD

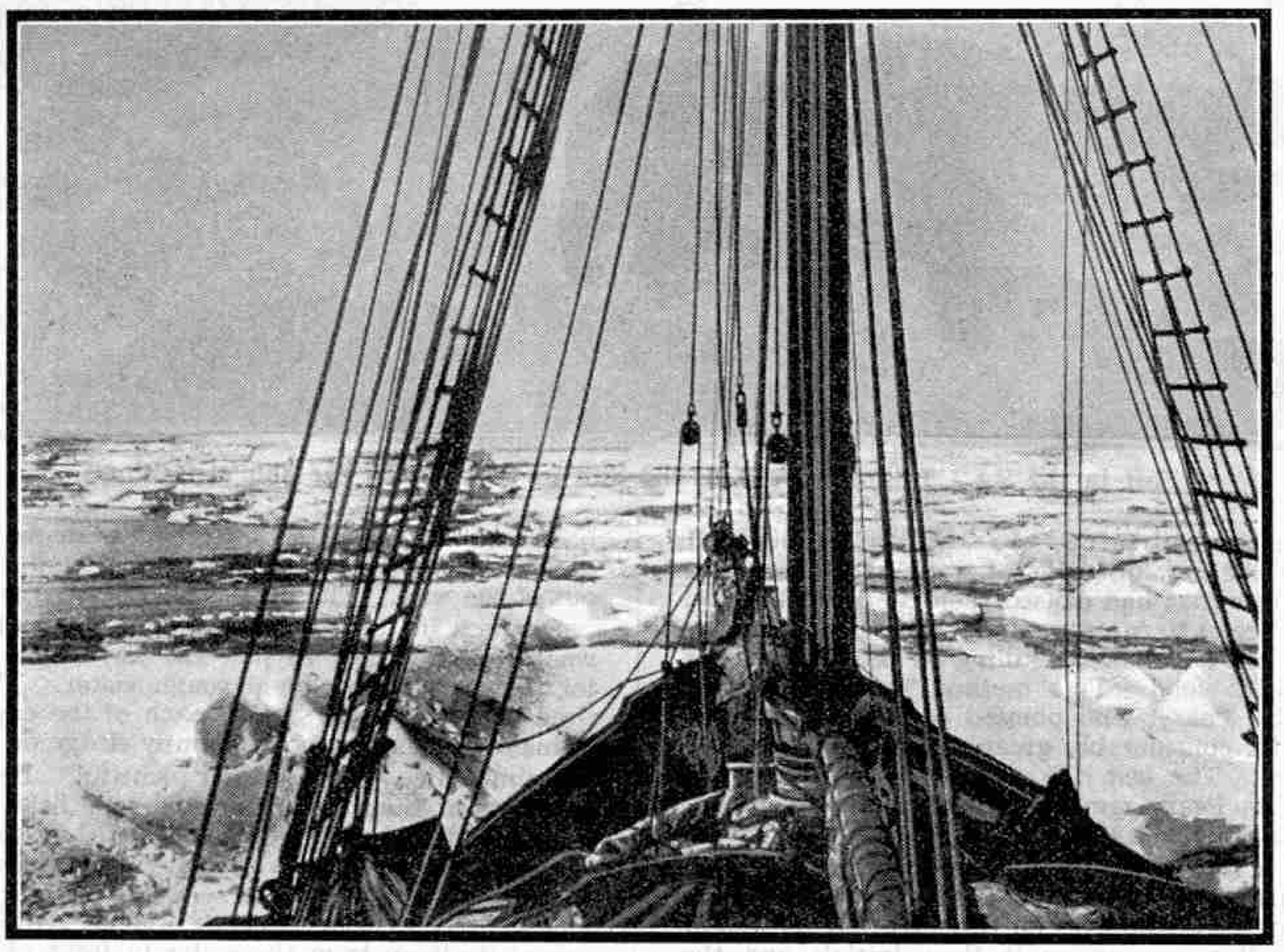
LAST month we described how Nansen had determined to make a dash northward by sledge after he had discovered that his drift would not take him sufficiently near the Pole.

Looking ahead for the moment, it may be remarked that when the safe return of the "*Fram*" had proved Greely to be completely wrong in his prophecies of disaster, he deliberately accused Nansen of deserting the ship. The truth was that Nansen realised that the "*Fram*" was in very little danger, whereas the journey over the frozen sea was distinctly hazardous. for retreat in case of disaster was absolutely cut off. The drift of the "*Fram*" was too irregular to enable the Polar party to find her again, and the only route by which they could return to civilisation once more was by way of Franz Josef Land or Spitzbergen. This would involve a long and arduous journey over the pack ice and possibly a stay in the Arctic for at least one winter, during which reliance would have to be placed on bears, seals, and walrus for food.

Nansen was not in the least perturbed by the risk. He believed that a safe line of retreat meant an early retreat, and this did not accord with his aims. He had taken a risk in crossing Greenland, when his only hope of safety was to carry out his plans completely, and he decided to take a similar risk on this expedition also.

For his companion Nansen chose Lieutenant Johansen, whose interest in the expedition had been so keen that he had joined as a stoker rather than remain behind. During the long drift he had acted as assistant meteorologist and he proved himself an ideal companion for his indomitable leader. It is generally supposed that two men dwelling in solitude will acquire a thorough dislike for each other's company, but when Johansen was asked about this on his return to Norway, he said the only thing that ever happened was that Nansen kicked him in the back when he snored!

As the date for the start approached, every man on board became busy. Sledges with convex runners rather more than three inches in width were made to suit the special conditions to be met with on the ice. The runners were covered with a thin plate of German silver, an alloy that wears well, remains smooth and does not rust. As it was probable that open leads in the ice and, further south, stretches of open water would be met with, two kayaks, or decked skin canoes of the type that had become familiar to Nansen during his stay in Greenland, were carried on the sledges. The latter were also well loaded with foodstuffs, clothing, instruments and a tent, while a cooker, a lamp and petroleum for fuel were also carried. Three sledges drawn by 28 dogs formed the caravan.



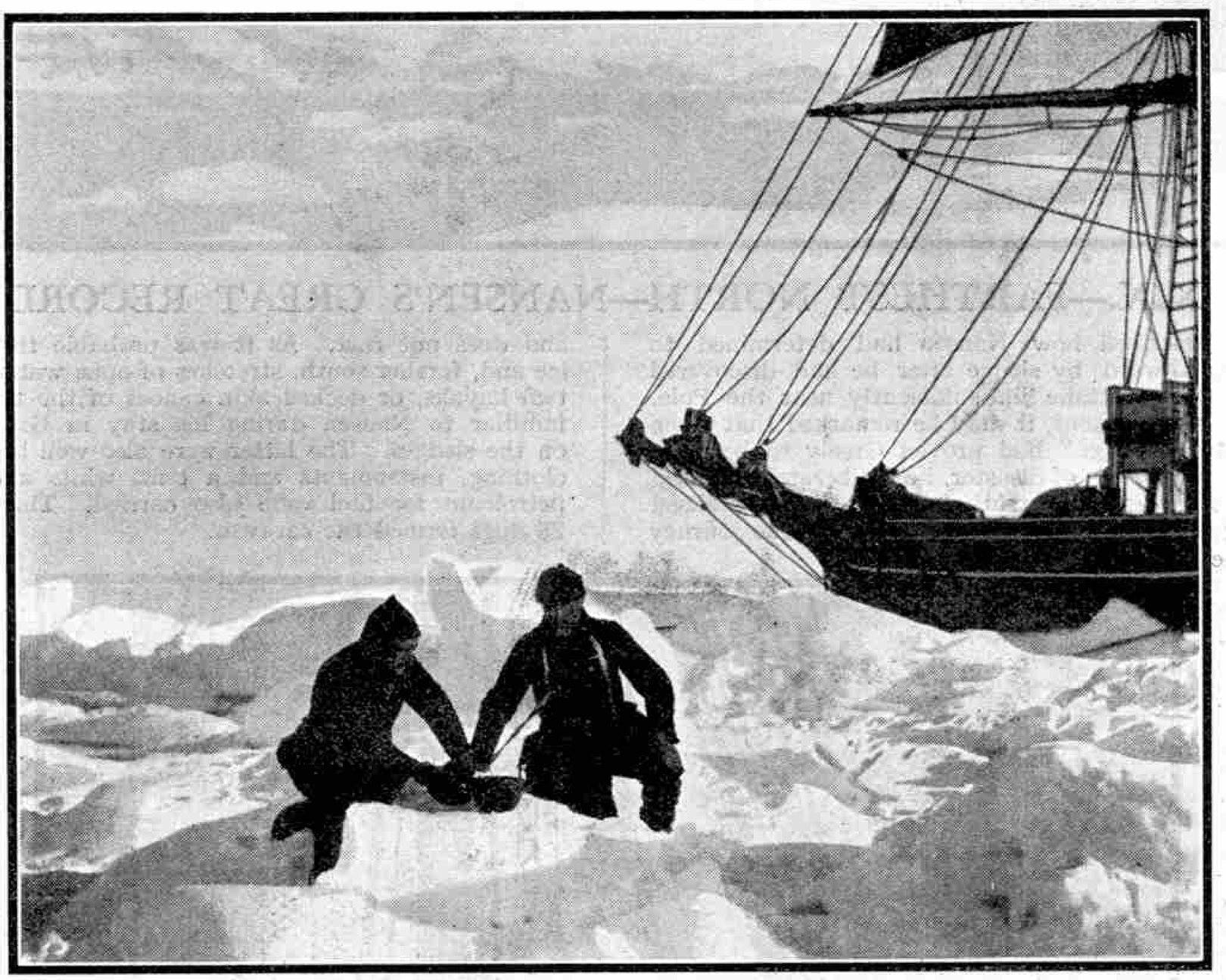
Pushing northward through seas covered as far as the eye can see with thin ice

The clothing of the explorers is of some interest. After many experiments Nansen decided to rely on woollen materials in preference to wolf-skins. The latter absorbed moisture from the body too readily, and froze easily in consequence. An outer suit of thin, closely-woven cotton canvas was worn for protection from wind and fine snow, the upper portion being provided with a hood. Finnish shoes made of the skin of the hind legs of reindeer, with sennegras inside to absorb moisture, proved satisfactory for travelling on snow shoes, while boots of ox hide with soles of sealskin were used in warmer weather. The sleeping bag—in which Johansen snored and Nansen kicked—was made of reindeer-skin, while the silk tent taken weighed only 3 lb., including the weight of the 16 pegs.

After two false starts and returns for adjustments, the hardy pair said good-bye for the third time on 14th March 1895, and set off northward. On the march Nansen usually went first to find a way through the uneven ice, his own sledge coming next, followed by the two others in Johansen's charge. The work was hard and both men were kept busy helping the dogs to heave the sledges over the terrible ice ridges. In the evening the tent was pitched behind a hummock in order to give shelter from the piercing wind, and while Johansen tethered and fed the dogs, Nansen started the cooker. Later they crept into the sleeping bag to thaw. During the day moisture exhaled from their bodies condensed in their garments, which were subsequently frozen into complete suits of ice armour. So stiff did they become that the sleeve of Nansen's coat cut a deep wound in his wrist, which became frost-bitten and did not heal completely until the following summer.

In the bag the ice melted and the explorers lay with chattering teeth during the process. After about an hour and a half of this they would begin to feel a little warmer, and by that time the hot supper would be ready. This was the supreme moment of their Arctic life. Next morning, however, a few minutes sufficed to freeze their clothes once more!

The original intention was to travel for 50 days before returning south for Franz Josef Land. The ice grew more and more chaotic and progress more and more difficult, until Nansen was at last forced to the conclusion that it was not only impossible to reach the Pole, but even to make any further advance at all with advantage. As far as the eye could reach to the north the same rough ice covered with thin loose snow extended, with ridges over which it was necessary to lift the sledges almost bodily. Accordingly, on 8th April, 26 days after leaving the ship, the attempt to reach the Pole was reluctantly abandoned when it was still 260 miles away, and a course was shaped for Cape Fligely in Franz Josef Land, more than 300 miles to the south west. Nansen's gallant attempt had taken him nearly 200 miles nearer the Pole than the previous farthest north attained by Lockwood.



Fast in the ice. Taking a sight of the Sun in order to fix the ship's position

The going at once proved surprisingly good. In view of the difficulties met with on the struggle northward, Nansen was at first greatly puzzled by this, and began to wonder if he had turned too soon. He thought it possible, however, that the new direction of travel was parallel to that of the pressure ridges that had caused them so much trouble. Food for the dogs now began to run short, and it became necessary to resort to the unpleasant expedient of killing off the weaker ones to provide the rest with food. This method was deliberately adopted a little later by Peary, who pointed out that it enabled him to take the dogs for considerably greater distances, although in diminishing numbers. The last dog could not be fed to any others, of course, but as Peary remarked, it still had its uses—but dog-meat was horribly tough!

A notable find was a huge piece of timber that was observed sticking up from the surface of the ice. This was probably Siberian larch. The explorers cast longing eyes on this fuel, but its weight was prohibitive, and after carving on it their initials and the latitude, they left it to pursue its Fram-like drift across the Polar Ocean.

In making their way south no use whatever was at first made of the kayaks, which were left mounted on the sledges even when open leads in the ice were encountered. Nansen wished to save them for work in the neighbourhood of Franz Josef Land later in the season, and feared that thin ice on leads in the more northerly latitudes would damage the frail craft. When a lead was encountered, therefore, it was either followed to left or right until a crossing was possible, or the explorers camped and slept until it became frozen over. At times both dogs and men broke through thin ice in making these somewhat perilous crossings, but no serious mishap occurred.

By the middle of July the weather had become warmer and open leads were more numerous and wider. It then became necessary to make use of the kayaks. On arrival at a lead, the vessels were launched and held side by side by snow-shoes pushed through straps. The sledges were then run out and fastened on top of the kayaks, one ahead and the other astern. The convoy was completed when the dogs had perched themselves on top of the sledges and the two explorers paddled the outfit over the lead. The kayaks were scarcely water-tight and the small hand-pumps fitted to them were often in use. Nevertheless, the change from pulling sledges proved very pleasant and both men wished that they could complete their journey in that manner.

Land was at last sighted. It had really been in sight for several days but had always been supposed to be clouds. The open sea, too, was reached at about the same time, to be greeted with acclamation as the way home.

Two days before finally saying good-bye to the densely packed ice an adventure occurred that nearly had tragic results. After an exhausting day in thick mist that prevented them from seeing more than a hundred yards ahead, Nansen was making preparations to cross a lead in his kayak when he heard a scuffle behind him. Turning quickly, he saw an enormous bear standing over Johansen, who was lying on his back on the ice and doing his best to prevent the animal from biting him. The guns were in the kayaks, and in reaching hastily for one of them, Nansen knocked his vessel into the water. What seemed to him an eternity elapsed before he could pull the kayak back on the ice, extract his gun and turn round to shoot. Fortunately the attention of the bear had been disturbed by the barking of one of the dogs, and Johansen had succeeded in wriggling out of the way. The bear paid the usual penalty.

Progress in the open water was easier than on the ice, and it was only necessary to pull the kayaks up on the floes to camp for the night or to avoid rough water. The sledges had by this time been cut down so that each of the explorers paddled himself in his own vessel with his stumpy sledge on the cover behind him.

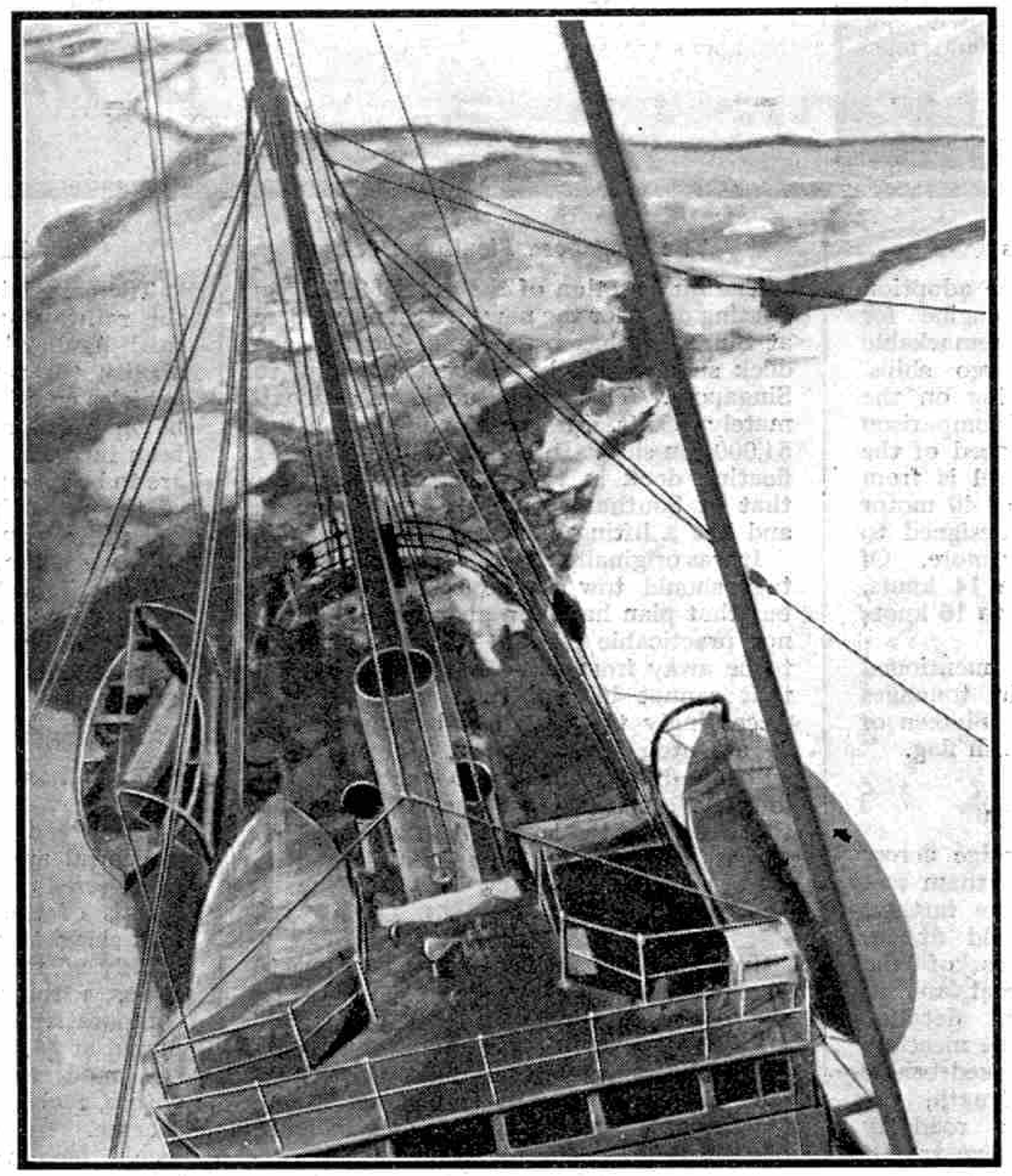
Animal life was more than plentiful. Bear and fox tracks were so common that the men took very little notice of them, while walrus and seal were often met with and provided welcome additions to the larder. Some of the experiences with walrus were quite alarming. On one occasion Nansen's kayak received a violent shock from beneath. Next moment a gigantic walrus reared itself up from the water in front of Johansen, who backed hurriedly. The animal crashed into the water again, dived and came up on the other side of the kayak, and finally compelled Johansen to scramble on the ice. Nansen tried to follow his example. Unfortunately the ice on which he attempted to land broke off, and to save himself from a cold bath he was compelled to cling to his kayak, which drifted away and very nearly capsized. When he succeeded in reaching the ice the walrus swam round and round the floe and showed signs of attacking. Rather than waste a bullet on the infuriated beast the two men made the best of the situation by having dinner.

Later a herd of walrus lying on the ice was encountered. They were undisturbed by the approach of Nansen and his companion, and continued their usual custom of poking one another in the back with their long tusks and grunting in chorus as they greeted new comers from the water with their apparently well-meant blows. When two were shot the rest simply plunged into the water, one only remaining on the ice in a bewildered state.

The end of the travelling season found the explorers on what

they believed to be Franz Josef Land. They were very uncertain with regard to their exact position, as their watches had stopped on one occasion during their travels and in consequence they had no method of determining their longitude with certainty. Later it transpired that they had restarted their watches about 26 minutes wrong, making a difference of about six-and-a-half seconds in longitude. In the belief that they were too far to the west they struck off south eastward at one point, but were fortunately recalled by the sight of land.

Selecting a suitable spot on the large island now known as Frederick Jackson Island, they set about building a hut for shelter during the winter. A piece of driftwood found on the shore served as the ridge piece and the walls were made of stones collected on the shore. Their dwelling place was of no great height and to give themselves headroom, they dug three feet down into the ground with a spade made by fastening the shoulder-blade of a walrus to a broken snow-shoe staff. Walrus hides were used for the roof and the remarkable edifice was completed by benches of stone upon which to lie, and a fireplace for the blubber stove. The stone benches made very uncomfortable beds, and the smoke and grime of the burning blubber made the explorers so black and dirty that repeated scrubbings were necessary to restore their normal appearance when they reached the comforts of civilization once more. Their clothes became so appallingly greasy that it was impossible to wash them clean, the only method by which any real effect could be produced being to scrape them with a knife while warm.



Looking backward from the crow's nest at the narrow lane between the floes through which the vessel has passed

Life in the hut was comparatively luxurious, nevertheless. The food was plentiful, bears continually arriving in search of something to eat and remaining behind to furnish it instead. Practically the only real hardship was lack of reading matter. Apart from navigation tables, all they had was an almanac, and Nansen almost learned the usual miscellaneous contents of this from memory!

When spring came round once more they set off for Spitzbergen in the expectation of meeting a vessel to take them back to Norway. As they went south over the ice surrounding the islands they came to realise that it was really Franz Josef Land on which they had wintered, and at last they came to a place that they recognised from the maps made by previous explorers as being on the south coast of Franz Josef Land. Here the ice extended for some distance from the land and they turned west along the ice edge with hopes of reaching Spitzbergen easily.

It was at this time that they had their second narrow escape from disaster. Landing on the ice with the intention of climbing an ice hummock to survey their course, they left their frail vessels insecurely tied and suddenly espied them drifting away with their food, guns, knives and spare clothing in them. Drastic action was necessary and Nansen showed himself to be possessed of the highest qualities of an explorer and leader by plunging immediately into the sea to swim after the kayaks. After a terrible struggle in the icy water he reached them, but was almost too cold and exhausted to do anything when he arrived. Eventually he just managed to pull himself up into the kayaks and slowly paddled back.

In the meantime Johansen walked up and down the ice in an agony of apprehension, for he knew that their chances of survival were very small indeed if the kayaks were not recovered. He was further disturbed by hearing a shot that suggested some accident. What had happened was that Nansen had shot two auks while paddling back to the ice edge.

A day or two later a walrus attacked Nansen with great ferocity and thrust its tusk through the shell of his kayak. The leak was soon perceived but the kayak sank on an ice ledge under water and everything in it was completely soaked.

The rent in the kayak was mended after some trouble, but the necessity for it suddenly disappeared completely. Ascending a hummock to look ahead along the ice edge, Nansen thought he heard the barking of a dog. The sound was repeated and finally he set off north to investigate, leaving Johansen encamped. As he strode along on his snow shoes he saw the tracks of many foxes and of a similar animal that made a larger mark. All at once he heard a shout and saw a dark figure approaching him. When close enough to see the features of this unexpected human being Nansen concluded that it must be Jackson, an English explorer whom he knew to have contemplated an expedition to Franz Josef Land, and he greeted him accordingly.

At first Jackson had not the slightest suspicion of the identity of this grimy individual in rags, and began to ask questions about the stranger's ship. Suddenly he stopped, looked intently at him for a moment, and then asked if he were Nansen. On receiving the answer his welcome, already cordial, became exuberant. Assuring Nansen that there was plenty of room in his hut he took him there and sent out members of his crew to bring in Johansen.

When the possibility of meeting other explorers was realised, Johansen's first thought was that they would stay for a few days and then continue their journey to Spitzbergen. This intention makes it quite clear that there was never any question of rescuing Nansen and Johansen. They had spent 15 months alone in the Arctic, living for a large proportion of the time on animals found and shot by them, and they were quite capable of completing their journey according to their original intentions. But when they learned that Jackson's ship was expected almost daily they decided to await its coming. Finally they returned to Norway on 15th August 1896.

Five days later the telegraph operator at Skjervo, on the north coast of Norway, was knocked up a little after three o'clock in the morning. He opened the door in a very unamiable frame of mind, but recovered his temper very quickly when he learned that his nocturnal visitor was Sverdrup! The "*Fram*" had been released from the ice near Spitzbergen, and Sverdrup had made for Norway with the intention of returning to Franz Josef Land to search for his leader. He learned that no search was necessary and very soon the members of the expedition were re-united.

Not only had the farthest north been reached by Nansen and his companion, but the "*Fram*" had reached a latticude of 85° 55′ during her drift, and thus obtained the distinction of having been considerably farther north than any other vessel.

Although the distance that still remained to be covered in attaining the Pole was only 260 miles, it was 14 years before they were covered. Nansen's record was beaten by Cagni, an Italian, but the honour of reaching the Pole was reserved for Robert E. Peary. How he achieved a life-long ambition will be told next month.



Engineering News of the Month

Faster Cargo Vessels

An interesting outcome of the adoption of the internal combustion engine for marine purposes has been the remarkable increase in the speed of cargo ships. "*The Motor Ship*," commenting on the fact, states that for purposes of comparison it may be assumed that the speed of the average present-day cargo vessel is from 10 to 11 knots, whereas each of 40 motor cargo ships now on order is designed to develop a speed of 14 knots or more. Of these, 17 ships are to average 14 knots, eight 14½ knots, seven from 15 to 16 knots and eight from 16 to 16½.

Practically all the new ships mentioned are comparatively big, their tonnages ranging from 5,000 to 10,000. Sixteen of them are to sail under the British flag.

* * * *

Proposed Ribble Bridge

The proposal to build a bridge across the Ribble Estuary between Lytham and Southport has advanced a stage further. A conference was recently held at St. Annes between representatives of the Lancashire local authorities that are interested in the scheme, and detailed proposals were placed before the meeting. These provided for a double decked bridge approximately 2½ miles in length, the higher level to consist of a roadway capable of carrying heavy modern traffic, while the lower level would handle passenger traffic by means of the rail-plane system of cars. At the actual point at which the bridge would cross the Ribble channel there would be a navigation span 600 ft. in length and a headroom of 85 ft. The Preston Corporation, who are responsible for the control of the Ribble Estuary, no doubt will object to this last figure, for they require a clearance of 181 ft. at high water mark.

* * * *

Navigating Ships in Fog

The Havre harbour authorities have been experimenting for some months past with a new signalling system invented by a naval officer, for navigating ships into harbour during fog. The system employs two aerials emitting continuous signals which, on meeting, neutralise one another in such a manner that a "zone of silence" representing the width of the navigable channel is created between them. A receiver on a ship moving up channel shows by characteristic sounds when the vessel is off her course. The sounds increase in intensity with the increase in the distance from the course, so that it is easy for the pilot to keep to the safe route. It is stated that the signals are audible at a distance of from five to six miles.

The Singapore Floating Dock

The final section of the great 50,000-ton floating dock for the new British naval base at Singapore has been completed and the dock shortly will be ready for towing to Singapore. This great dock is approximately 850 ft. in length and can lift a 54,000-ton ship. It is not quite the largest floating dock in the world, however, for that at Southampton is 960 ft. in length and has a lifting capacity of 60,000 tons.

It was originally intended that Admiralty tugs should tow the dock to Singapore, but that plan has been abandoned, as it is not practicable for the Government tugs to be away from the country for a period that cannot be less than three months. Accordingly the task has been entrusted to a Dutch tug company, and the dock will be divided into two parts for the journey. A feature of special interest is that it will be the largest floating structure to pass through the Suez Canal.

* * * *

Salving the "*Seydlitz*"

In our December notes we referred to Messrs. Cox and Danks' salvage work on the scuttled German battleship "*Seydlitz*" at Scapa Flow. With favourable conditions it is anticipated that this vessel will have been floated and towed ashore by June. It is lying on its side in 80 ft. of water, its beam of 93 ft. having prevented it from completely turning turtle and resting keel uppermost, as was the case with the majority of the scuttled ships. The method of treatment adopted is to stop up all gaps in the hull and superstructure with concrete, and to fill the ship with compressed air. In March the stern of the ship was raised several feet.

* * * *

New York Sky Signs

A survey of electric sky signs recently carried out in New York showed that there are now 20,880 electric signs used for advertising purposes in the Manhattan Island district. These signs employ 1,309,918 lamps.

The value of this form of advertising is shown by the extraordinary demand for space on the best sites. It has reached such a pitch that one syndicate has bought up an hotel in the central district of New York and proposes to use the whole of its frontage, with the exception of that on the ground and first floors, for sign space. The two lower floors are not high enough for convenient use and will be occupied by department stores. It is said that by boarding up the windows of the other floors and letting the space off for sky signs a considerably greater income can be produced than would be secured by the ordinary letting of the rooms of the hotel.

Restricted Bridges

The complaints of Midland traders that the railway and canal companies restrict road hauliers' activities by declining to abolish the restrictions on the weight of vehicles crossing their bridges seem now to be approaching satisfaction. A Bill has been introduced under which such bridges are to be taken over by the local authorities of the areas in which they are situated. The railway and canal companies thereafter will pay a lump sum each year in respect of their liability for maintenance, and the local authorities will reconstruct or strengthen the bridges to suit modern traffic requirements.

* * * *

Birmingham-Merseyside Motor Road

There has been a considerable degree of support forthcoming for the proposed motor road between the Birmingham industrial area and Birkenhead, to which we referred in our January notes. Further details of the scheme are now available and show that the road will be approximately 90 miles in length, fenced on both sides, without any serious bends and comparatively level. The cost is estimated at £6,000,000 and it is believed that the road will be brought into service within two years of the adoption of the scheme. In order to do this 10,000 men would have to be employed in its construction.

The main idea behind the project is to make it possible to take merchandise direct from the factories to the docks without any unnecessary delay in transit. It is stated that the double journey on the new road could be made in the time that it now takes to make the single journey.

The volume of traffic between Merseyside and Birmingham even at present is more than adequate to make the proposed motor road a paying undertaking on the basis of a toll of ¼d. per ton mile, this charge including the weight of the vehicle as well as the load carried.

* * * *

British Motor Car Exports

The British-made motor car continues to enjoy increasing popularity in overseas markets. Recently published statistics of British motor exports show that in 1923 the total value of private cars, commercial vehicles, chassis, parts and accessories exported was approximately £5,700,000. In 1927 this had grown to approximately £40,000,000 and before the end of that year the figures were improving month by month.

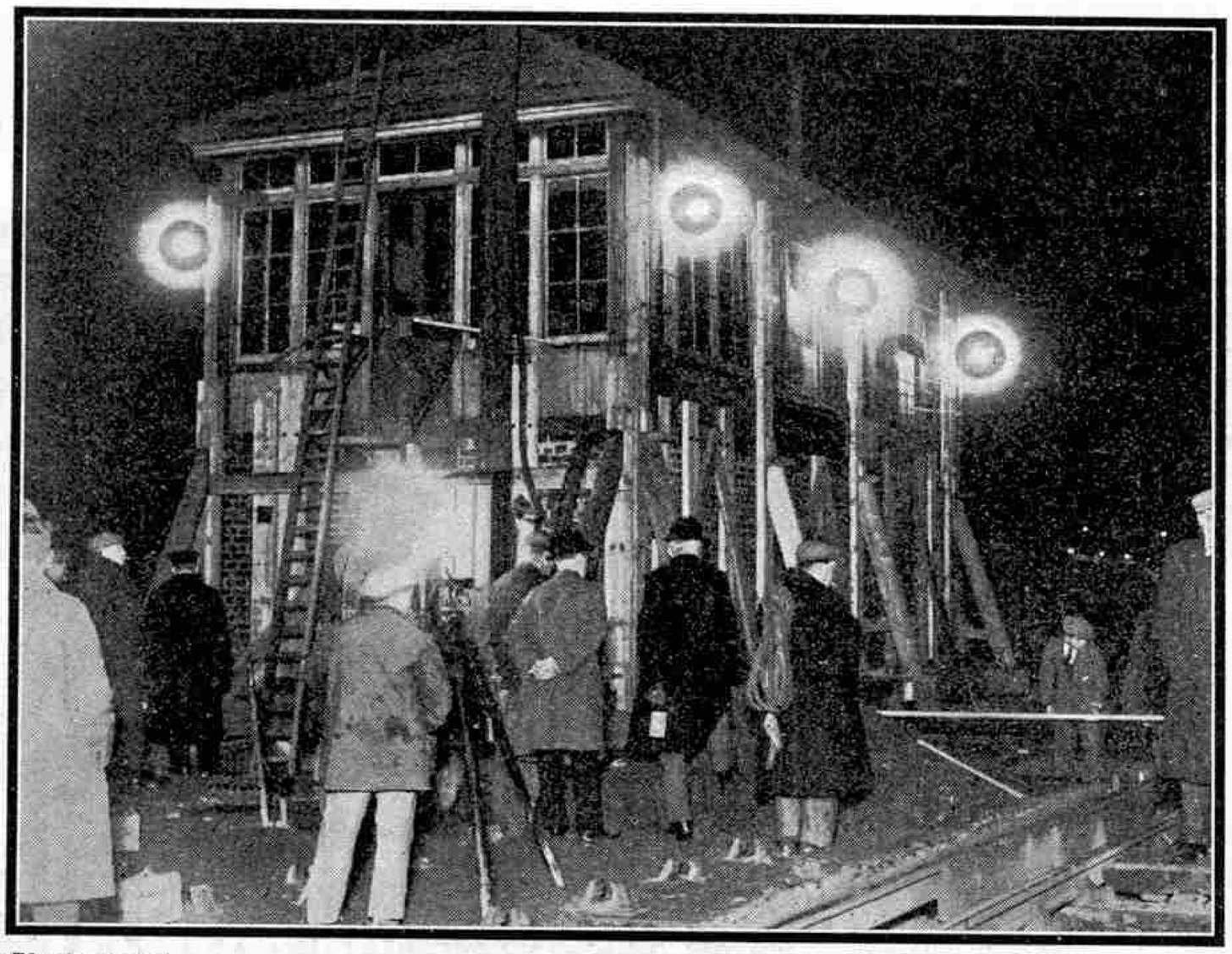
The exports went principally to British South Africa, Australia, British Malaya, New Zealand and the Argentine. Australia claimed nearly 50 per cent. of the total.

Moving a 50-Ton Signal Box

A novel piece of engineering work was carried out on the Southern Railway at Wimbledon recently when a 50-ton signal box, measuring 31 ft. in length by 13 ft. in width and containing 64 levers, was moved bodily for a distance of approximately 8 ft. This work formed part of the reconstruction scheme that is being pushed ahead at Wimbledon Station, and was rendered necessary by alterations that are being made in the running lines at this point.

To enable the signal cabin to be moved it was raised up on timber baulks to each end of which specially constructed trolleys were fitted. A concrete bed was laid down between the old site lying between the up-through and down-through main lines, and the new position which is on a spot previously occupied by the down-through line; and on this bed the trolleys moved the structure to its new home by means of a winch operated by eight labourers. Eventually the down-through line will be relaid on the site previously occupied by the signal box.

The actual move was commenced and carried out within the short space of 60 minutes!



[*Photo courtesy*] [*Southern Railway*

Moving a 50-ton signal box on the Southern Railway (see paragraph on this page)

* * * *

The Engelberg Aerial Railway

The first aerial cable passenger railway in Switzerland has been opened for service between Gerschnialp and Trübsee. The railway has been introduced to improve the facilities offered to visitors for ski-ing, lugeing and curling, and will be particularly useful on those mild winter days when ice sports are out of the question in the valley. It will haul visitors from an altitude of 4,400 ft. to 6,000 ft., well above the snow line, in nine minutes, and will be very convenient for ski-ers who wish to make a rapid ascent preparatory to enjoying what is claimed to be the longest down-hill run in Switzerland. The carriage will provide accommodation for 16 passengers and is suspended in mid-air from four 3 in. wire cables.

* * * *

A demonstration of the efficiency of trans-Atlantic wireless telephony was made at a joint meeting of the Institution of Electrical Engineers and the American Institution of Electrical Engineers held simultaneously in London and New York. The speeches made in New York were heard in London and those made in London were heard in New York without the slightest difficulty.

* * * *

It is stated that the world's annual consumption of electric lamps is 600,000,000. Of this quantity approximately five per cent. are used in this country.

Brick-Paved Roads

Experiments are being carried out in London, at the Great Western Railway goods yard at Westbourne Park and the Chelsea Borough Council municipal depot, with a road surface of brick. For the bricks under test a high resistance to the wear and tear of heavy road traffic is claimed, for the crushing strain is stated to be as high as that of best Staffordshire blue bricks. They split only at right angles to the wearing surface, which has a texture that affords a firm foothold. The bricks are laid on a layer of sand spread over a concrete road bed. Over 2,000,000 sq. yds. of this type of pavement have been laid in the United States within recent years.

* * * *

Vancouver Rings up London

A conversation was held recently between Vancouver and London, when a Vancouver business man had occasion to ring up his London representative. The two points are approximately 7,000 miles apart, but it is stated that the conversation throughout was quite distinct. The cost of the call, which lasted four minutes, was £15.

* * * *

Electric Power Development in Ontario

The Hon. J. D. Monteith, Provincial Treasurer of Ontario, in his budget speech before the Legislature of the Province stated that the total horsepower in use by the Ontario Hydro-Electric Power Commission is now 1,600,000, and that another million horsepower is available. The Commission operate the largest power enterprise under public ownership in the world. The total available undeveloped power in the Province is estimated at 5,000,000 h.p. The number of miles of transmission lines is 7,066. In 1927 there were constructed 807 miles of rural transmission lines, and the total number of homes now served by the Commission is 420,000.

A Remarkable Power Installation

One of the most remarkable hydro-electric power plants in North America is about to be brought into operation in British Columbia. This is the Alouette plant of the British Columbia Electric Railway Company, which is adding 12,500 h.p. to the power system at a cost of £500,000. It will be unique in that no operator will be needed, the single generator being controlled from the Stave Falls power house 11½ miles away.

Another unique feature is that water that ordinarily would find its way down the Alouette River to the Fraser River is being diverted through a tunnel, driven 3,400 ft. under the mountain range, into Stave Lake. In this manner the water will be used for power development at the Alouette plant and again at the Stave Falls plant, while at a later period it will be used a third time, when the company's plant at the first canyon of Stave River is built. The Alouette plant built at the mouth of the tunnel will utilise the head created by the difference in level of 140 ft. between Alouette and Stave Lakes. The storage capacity of Alouette Lake has been increased by a dam raising the lake level 45 ft.

The new plant is the second largest automatic power installation on the American continent, being exceeded in size only by a station in the State of Washington, U.S.A.

* * * *

Britain's First Electric "Policeman"

The first electric "policeman" to be employed in Great Britain took up its duties in Leeds recently. It is really an automatic traffic control device that has been installed at each of the four corners of one of the busiest crossings in the city. It consists of three discs, mounted one above the other. These are lighted alternately at intervals that can be adjusted to suit any conditions. The top disc is red, and when lit up shows the word "Stop," the middle disc is yellow with the word "Caution" and the bottom one is green with the word "Go."

When the disc showing "Stop" lights up, the first driver in the traffic stream approaching pulls up at a white line painted across the road. After a certain interval the red is switched off and the yellow appears for a few seconds. The driver then makes ready to start and moves off immediately the green light and the word "Go" appears. As the yellow reappears, drivers in the moving traffic stream get ready to pull up.

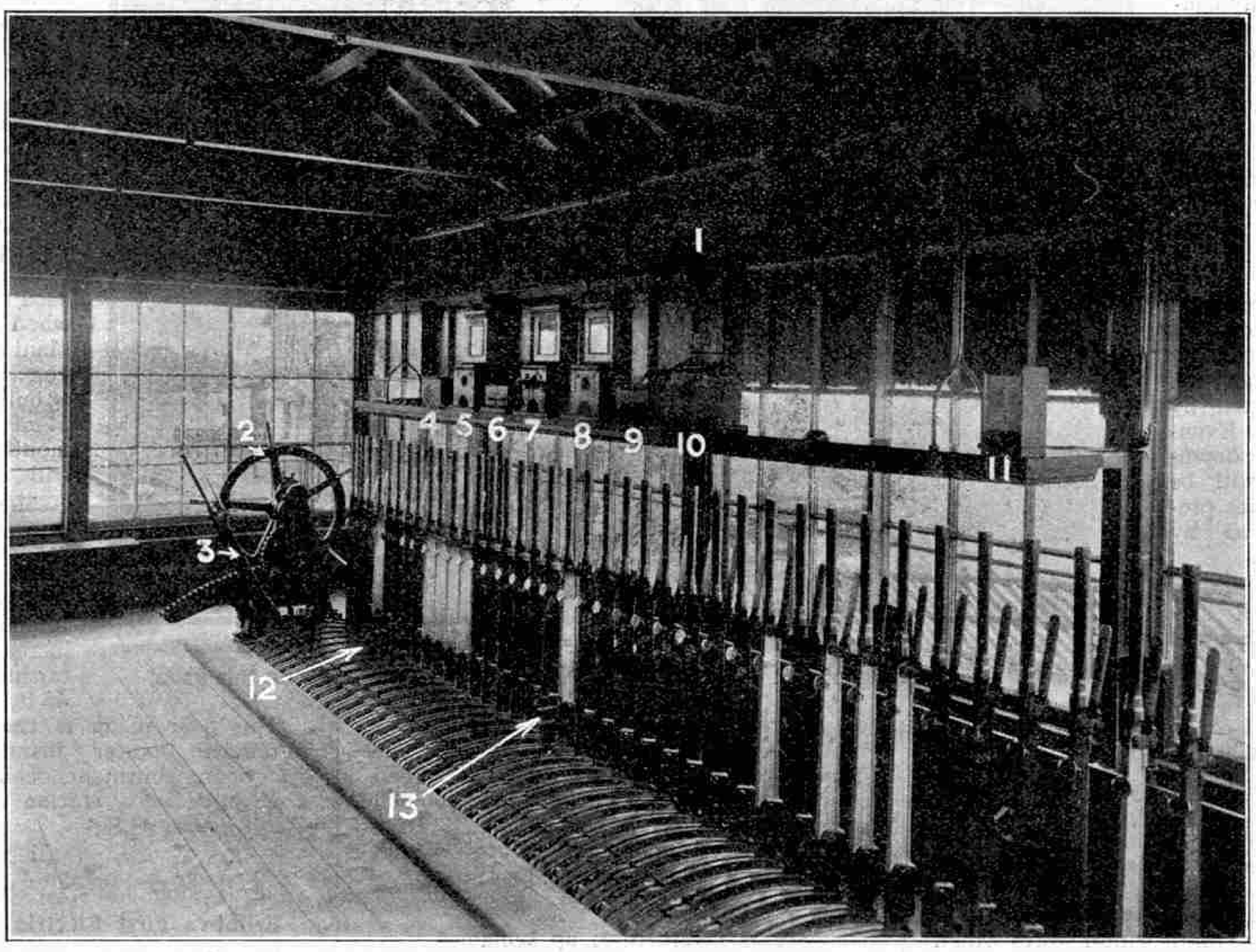
At one of the most important road junctions in Edinburgh, an almost identical scheme has been introduced.

What's Inside a Signal Box?

Railway Signalling on the L.N.E.R.

AS our readers know, railway signalling practice to-day is very different from what it was even a quarter of a century ago, while it bears no resemblance at all to the crude methods that obtained on the early railways. In those days it was considered quite sufficient to use, by day, rough boards of strange shapes (pulled round to present only an edge to the oncoming driver when the line was clear) and, by night, to throw into the air a shovel-full of hot cinders!

In the evolution of the signalling system that has taken place since those days simplicity of manipulation has always been aimed at. Nevertheless, the perfected system of to-day holds many mysteries—even for railwaymen not directly concerned with that branch of operation—and our readers will doubtless be interested to learn something of the practice employed on the L.N.E.R.



L.N.E.R. Signal Box Interior

It may be well to begin by enumerating the various instruments and appliances to be found in an ordinary signal box. To allow of this being done in the simplest possible fashion, we print on this page a keyed photograph of a signal cabin interior. The cabin may be taken as typical of hundreds of others. It serves a wayside station with two lines of rails, a level crossing and the usual little goods yard and sidings.

For convenience in describing, we will call the box (which faces north) "B," and assume that it serves a line running west to east. The box on the west side we will call "A," and the box on the east side "C."

The key to the photograph is as follows:—

LEVER FRAME. The levers seen in the photograph serve various purposes and are painted in different colours accordingly, namely:—

Red: stop signals—"Home," "Starting," and "Advanced starting."
Green (or Yellow): "Distant," or "warning" signals.
Black: points.
Blue: locking bars or "clearance" bars.
White: spare levers.

Numbers are painted on the sides of the levers to indicate the order in which the interlocking arrangements will allow the levers to be pulled over.

The lever on the extreme right of the photograph is No. 40. It is for a "distant" signal, and on its side are painted the figures 35, 36, 37, and 38, which means that these levers must be pulled over before 40 can be moved.

The names of the signals controlled by the various levers are shown on the board behind the frame. The minimum number of signals to be manipulated in any box for each train is three, viz.:—

1. Starting. 2. Home. 3. Distant.

but in the box illustrated there are five for each direction, viz.:—

1. Advanced starting signal: perhaps 600 or 700 yards in advance of the box.
2. Starting signal: at the end of platform.
3. Inner Home signal, protecting level crossing gates; just in rear of box.
4. Outer Home: up to 400 yards in rear of Inner Home.
5. Distant: 800 yards to rear of Outer Home.

Before the Distant signal (No. 5) can be lowered, signals 1 to 4 must *all* be lowered first, nor can signals 1 to 4 be lifted again until 5 has been restored to the "on" position. In the case of two trains approaching

the box illustrated from opposite directions, 10 levers may, therefore, be down together. This is the maximum number, all other levers (to sidings, etc., including the gate wheel) then being locked.

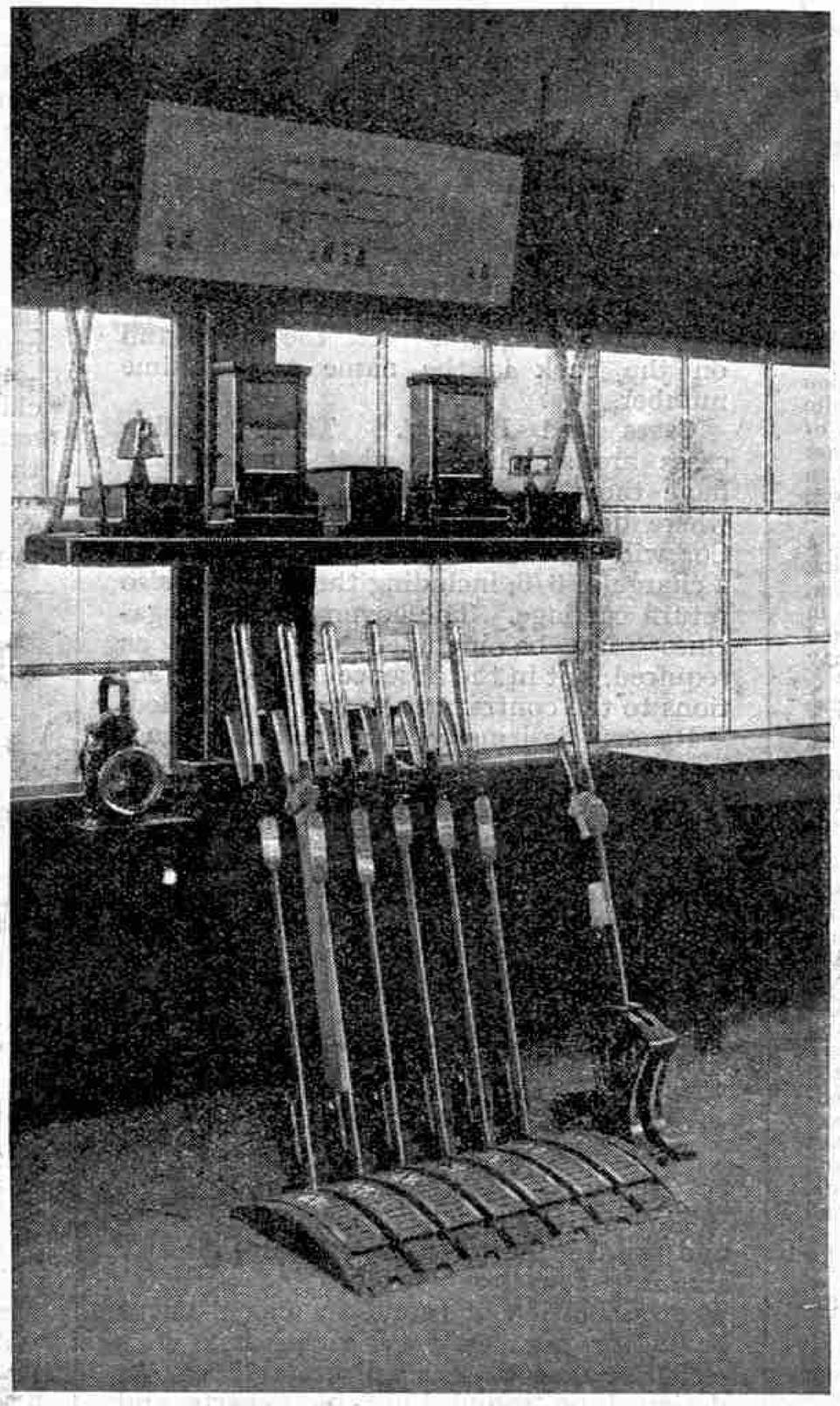
(1) DIAGRAM. Above the levers in every signal cabin is a coloured diagram showing the lines and lay-out controlled by the box and all signals and points manipulated by means of the lever frame, also the numbers of the levers by which they are worked.

(2) GATE WHEEL. This wheel opens and closes the gates on the level crossing. The interlocking of the levers prevents the gates being opened for the highway except when the railway signals are at danger.

(3) GATE STOP LEVER. This lever works the gate stops which rise above the ground and keep the gates firmly locked—an additional precaution for safety.

(4) BOX CONTAINING CUTTING-OUT SWITCH. This switch puts the block bells entirely out of circuit, so that box "A" to the west and box "C" to the east, are put into direct communication with each other. This makes one long section between boxes "A" and "C" in place of two shorter sections "'A' and 'B,'" and "'B' and 'C,'" and allows of the box ("B") being closed when traffic is light (*e.g.*, on Sundays).

Signals are normally kept lowered when a box is switched out, except where there is a level-crossing. The *king lever* (No. 13 on photograph) when raised and padlocked, prevents the movement of all levers, except those controlling the up and down main lines and the gates. These main line signals must, of course, be in the danger position before the gates can be opened for the highway.



Hand-operated Signal Levers, showing "releasing numbers." On the shelf above are the tapper bell and disc instruments

(5) BLOCK INSTRUMENT (WITHOUT HANDLE) FOR UP LINE; ADVANCE BLOCK SECTION INDICATOR. The signalman in box "B" has no control over this instrument. It is worked by the signalman at the box in advance and gives visual indication ("line clear," "train on line") of the state of the advance section on the west side, *i.e.*, the "up" line between "B" and "A."

(6) BLOCK BELL. This block bell is common to both up and down lines (*i.e.*, advance and rear sections) on the west side of the box.

(7) BLOCK INSTRUMENT (WITH HANDLE) FOR DOWN LINE: REAR SECTION INDICATOR. This instrument is controlled by the signalman in the box ("B") shown in the photograph. When this instrument is pegged over to show "line clear" or "train on line," it causes a simultaneous movement of the needle of the indicator of the "advance" instrument in the rear box (Box "A" to west).

(8) BLOCK INSTRUMENT (WITHOUT HANDLE) FOR DOWN LINE: ADVANCE SECTION INDICATOR. This instrument corresponds with No. 5, but is for the "down" line between "B" and "C." It is worked by signalman at the box in advance on the east side (Box "C.")

(9) BLOCK BELL. This bell corresponds with No. 6, and is common to both up and down lines, but on the east side of the box.

(10) BLOCK INSTRUMENT (WITH HANDLE) FOR UP LINE: REAR SECTION BLOCK INDICATOR. This corresponds with No. 7, but is for the "up" line on the east side of the box. It is worked by the signalman in the box ("B") shown in the photograph.

(11) REPEATER SIGNAL. This is a miniature signal which works in harmony with the "distant" signal ¾ of a mile or so away to show its position.

(12) DETONATOR PLACING MACHINE. This is the lever for working Wake's emergency detonator apparatus. Should an approaching train pass the home signal at danger, the signalman, by means of this apparatus, can instantly project a detonator on to the line and thus warn the driver. There is a similar lever at the opposite end of the signal frame (for the other main line) not seen in the photograph.

(13) "KING" LEVER. This lever is used to prevent the movement of all levers, except those controlling the up and down main line signals and can be padlocked in position. (See No. 4).

In an earlier paragraph we used the word "perfected" in describing the signalling system of to-day. The word is, of course, used in a relative sense, for the perfect railway system will never exist. Alterations and improvements are constantly being made to meet the ever-changing conditions of modern railway requirements, and economies are being effected by the installation of simpler methods. Recently, for example, a re-arrangement of tracks on the L.N.E.R. not only permitted an improvement in the signalling arrangements, but even made it possible to close 79 signal boxes, with a consequent annual saving of £33,000; this economy being effected without endangering in the least the safe working of the line. It is a fact that every innovation affecting signalling operations has been the outcome of the determination to eliminate, as far as is humanly and mechanically possible, the risk of accident.

The success of those efforts is best revealed by the simple statement that on British railways during 1925 only one passenger in every 4½ millions was injured. The ratio of fatal accidents was one in 1,700 millions.

OUR MAIL BAG



In this column the Editor replies to letters from his readers, from whom he is always pleased to hear. He receives hundreds of letters each day, but only those that deal with matters of general interest can be dealt with here.

Correspondents will help the Editor if they will write neatly in ink and on one side of the paper only.

G. E. Tonge (Farnworth).—We are greatly interested to hear that after having tried a variety of hobbies, including fretwork, you have come to the conclusion that Meccano is the best of all. You seem to be quite an expert on motor buses and we think your idea of specialising in bus models is quite good, for they are interesting to build and look very attractive when complete. We hope you are now feeling quite well and strong again.

H. G. Dyer (W. Hartlepool).—"We recently held a debate at school on 'Meccano versus Stamp Collecting as a Hobby.' Meccano won by 26 to 4." Which, of course, indicates a high standard of intelligence in your school. Thanks for your carefully prepared statistics and information on locos, etc., which may be of assistance to us.

J. Murray (Newlands, S.A.)—We know of course that we should enjoy the trip, but with a school of boys a hundred thousand strong always thirsting for Meccano Magazines, South Africa seems as far away as the moon. In fact the moon seems nearer because we can see it, and wonder if the man in it would like to see the current issue!

G. S. Willmott (Yeovil).—A monocoque machine has a one piece tail unit, operated by one control, the rudder and fins being made in one piece. The "Moth" is a good example of a monocoque machine. Thanks for telling us of the interesting reference to Meccano in your school chemistry text book.

G. Long (Karnup, W.A.)—"One day when I was at school the bushrangers held up the schoolmaster and stole the children's horses. They were caught eventually, but not until they had shot three mounted policemen. Another time I was caught in a sandstorm. I have killed three carpet snakes and a tiger snake 12 ft. long. The other day I found an insect 6 in. long with enormous wings, body all colours, and I got 10/- for it." Yours is an adventurous life, Godfrey, and we expect our British boys envy you. They only see such things on the cinema.

M. E. Broadbridge (Taiboku, Japan).—Thanks for your hints on how to make good tea. We have tried them with the best results. We much appreciate the special tea you have sent to us. We were very interested in your account of your Dragon Boat Festival—a very gorgeous affair evidently. We shall endeavour to acquire and illustrate the forthcoming new issue of Japanese stamps.

J. W. Fordham (Leicester).—It always gives us pleasure to hear from Meccano old boys, and we are especially pleased to know that you are renewing your interest in the hobby. You will find it much improved. We hope the "*M.M.*" will continue to prove interesting and helpful to you.

C. Hamilton (Edinburgh).—"I have had good luck ever since I joined the Meccano Guild." Not an unusual experience, Cecil. All the Guild boys who write us seem happy and fortunate.

W. E. Broadbridge (Formosa).—Your photographs of a sulphur mine are good and we think they would interest our readers. If you will send us the negatives we will publish them. We hope to be able to put you in touch with one or two other Meccano boys very soon.

N. E. Bagshaw (Wallasey).—All your letter is interesting, but the part that gives us most pleasure is where you tell us you have won a £100 scholarship. Your criticisms and suggestions are noted. We should get into serious trouble with a large number of our readers if we omitted the "Railway News" pages. Glad you find the "*M.M.*" "simply spiffing."

D. Craig (Rome).—"The last number of the "*M.M.*" went astray in the post. Will you please see that future addresses are clear so that the father of the family may not hear nothing else for weeks but the remark, "Why has my *Meccano Magazine* not come?" You realise the seriousness of the situation don't you?" We do, Mr. Craig, indeed we do, and we will take every possible precaution in future!

E. G. Ayling (Putney).—We are familiar with your father's work, and we should like also to see a few of your own drawings. "101% superlative" is a new, but doubtless an appropriate description of the "*M.M.*"

L. A. Morris (Sparkhill, Birmingham).—We read with much interest your account of your yacht race and we congratulate you on your win. We note that in your opinion the "*M.M.*" is "abso-blinking-lutely-top-hole." We are sure this means something complimentary.

Binding the "*M.M.*"

In response to a growing number of requests from our readers for binding cases, and enquiries as to where copies of the "*M.M.*" can be bound, we have made arrangements with Messrs. O. H. Bateman & Co., of 13, North John Street, Liverpool, to supply a special "*Meccano Magazine*" binding case for six Magazines and also to bind readers' Magazines when required.

Cases Only. The binding cases, which cost 3/6 each (post free), are supplied in what is known as "quarter Basil, full cloth." That is to say three-quarters of the sides are dark crimson cloth and the back and a quarter of the sides are dark crimson leather. The case is tastefully embossed in gold with the name "*Meccano Magazine*" on the front and on the back is the name and volume number.

Cases and Binding. These binding cases are supplied so that readers may have their magazines bound locally, but where desired Messrs. O. H. Bateman & Co. will bind "*Meccano Magazines*" at a charge of 6/6, including the case and also return carriage. The covers of the Magazines may be included or omitted as required, but in the absence of any instructions to the contrary they will be included.

Readers desiring to have their Magazines bound need only make a strong parcel of them, include a note of their name and address together with the necessary remittance, and send the parcel direct to Messrs. O. H. Bateman & Co., 13, North John Street, Liverpool, by parcel post, carriage paid. We understand that at present about two weeks are required to bind the volumes.

Model Sailing Yachts and Motor Boats

The model boating season is here again and suitable stretches of water are already showing considerable signs of activity. The fascination of running a model yacht or motor boat is very great, but it is essential that these small craft should be designed on sound lines by experts and strongly built in suitable material. An extremely interesting collection of model boats of all kinds is to be seen at the Clyde Model Dockyard, Argyll Arcade, Glasgow. The boats include yachts of all sizes, guaranteed to be fast racers either on ponds or on the open sea, and motor boats fitted either with clockwork or electric motors. In addition there are model ships' fittings of all kinds. Readers who are unable to visit the dockyard should obtain the art catalogue advertised on page 453, which will be sent post free for 4d. A unique feature of this catalogue is the series of realistic coloured illustrations of yachts and motor boats. Those who are contemplating building their own boats should obtain the catalogue of model ships' fittings, 1½d. post free.

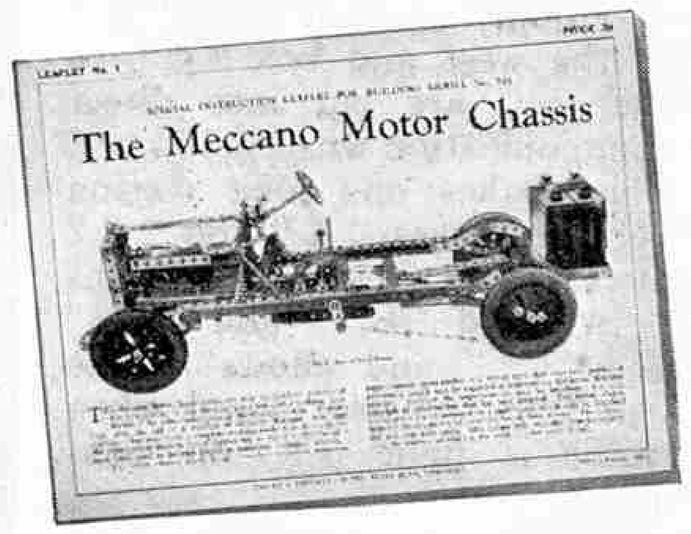
Film "Sharp-Eyes" Contest

Readers will be interested to know that the "Film Errors" contest announced in the Editorial of the July 1927 "*M.M.*" brought a gratifying number of entries. Although errors in film production are admittedly more difficult to detect than errors in drawings, that our readers upheld their reputation of alertness and love of accuracy was evident from the long lists of errors submitted.

The prize in the home section went to Gerald Symonds of Altwood Bailey, nr. Maidenhead, and the prize for the Overseas section to A. H. Hill of Cottesloe, Western Australia, to both of whom the Editor has sent an autographed copy of his book "*Engineering for Boys.*" These winners are to be commended upon their lists, which were not only lengthy, but sensible. If film producers had to cater for audiences composed solely of readers of the "*M.M.*"; their lot would indeed be a hard one, for they would have to "watch their step" even more than at present.

This competition threw an interesting side-light on the tastes of Meccano boys in general. It is noticeable that the criticisms—or at least 90 per cent. of them—are upon good films of the historical class, and of classics such as "*Dr. Jekyll and Mr. Hyde.*" This only goes to prove that our readers have a keen perception of what is good and what is worthless, a subject that was dealt with in the February Editorial.

New Model-Building Instruction Leaflets

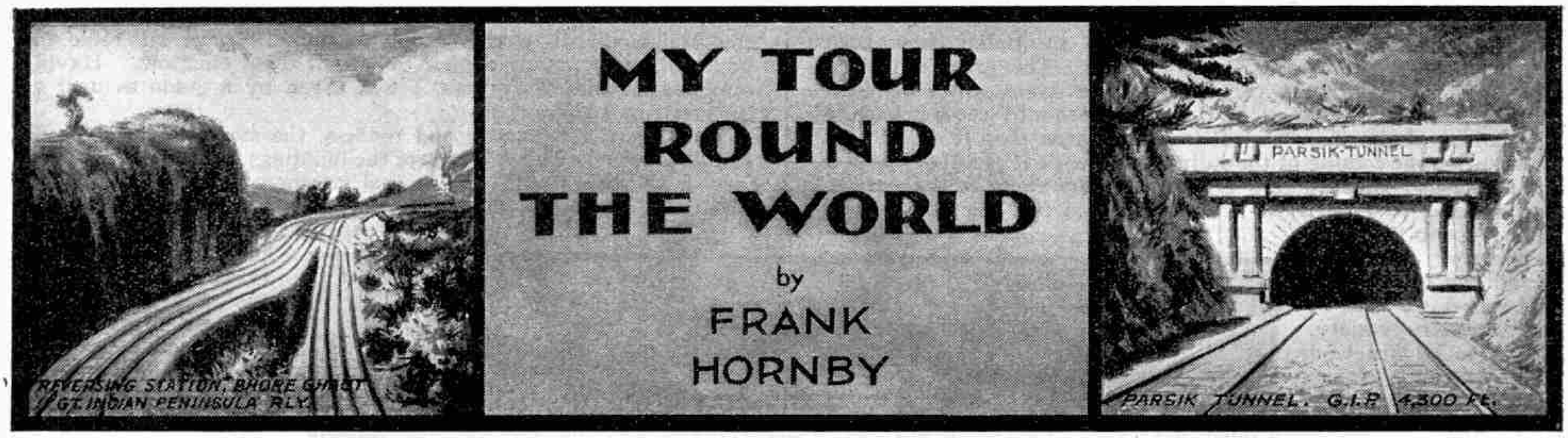


The full instructions for building the Meccano Motor Chassis may now be obtained in leaflet form from any Meccano dealer, price 3d. or direct from Meccano Ltd., Binns Road, Liverpool, price 3d. post free. This leaflet (No. 1) is beautifully printed on art paper, and all the illustrations are clearly reproduced making reference easy.

The Motor Chassis is the first of a series of super Meccano models for which instructions will be published in leaflet form during the next few months. These models will include the Block-setting Crane, High-speed Ship-coaler, Baltic Tank Locomotive, Pontoon Crane, Two-cylinder Horizontal Steam-engine, and many others equally interesting. An announcement will be made in these pages as each leaflet is ready for distribution.

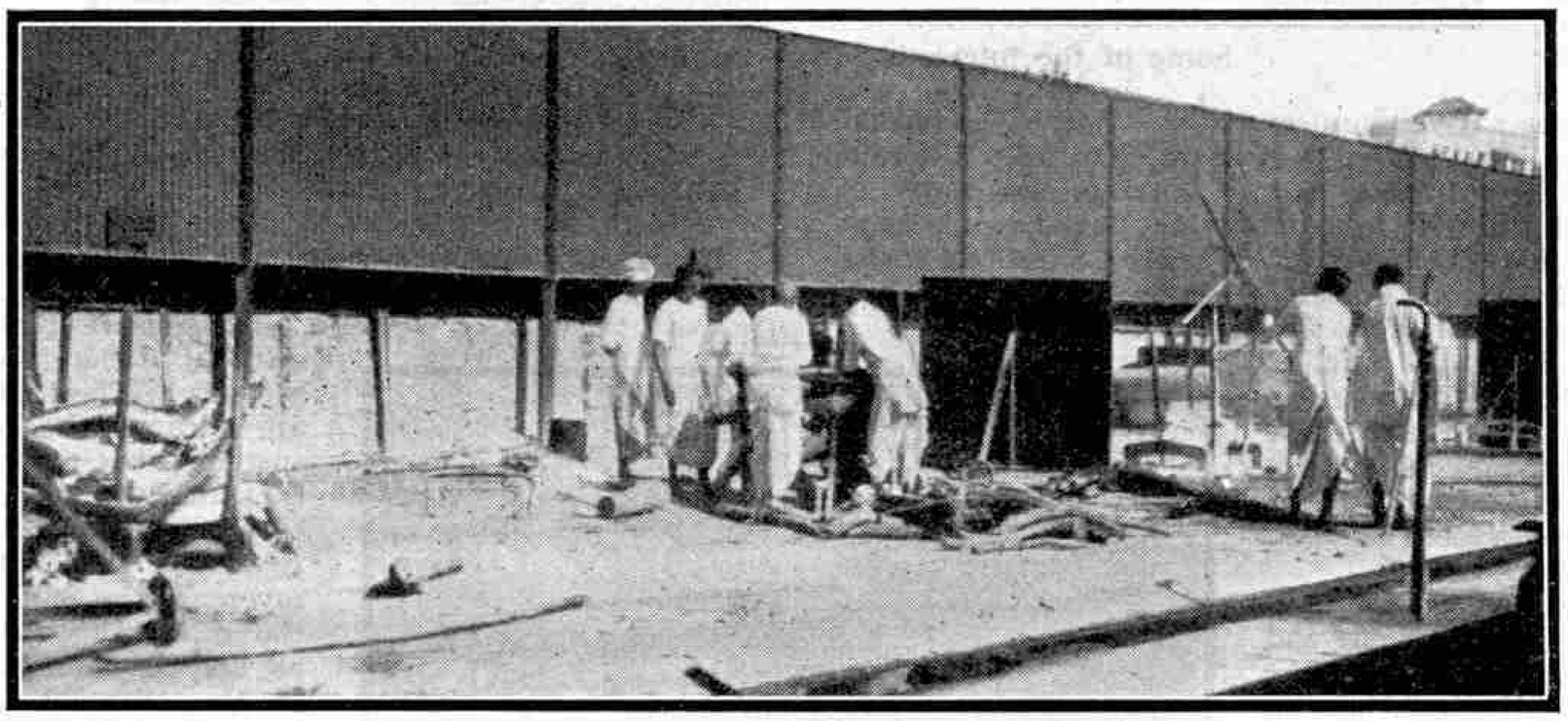
All the leaflets will be the same size of page as the Motor Chassis Leaflet, but as it will be necessary to describe some of the models at greater length than others, the number of pages will vary as circumstances require. The prices of the leaflets will be fixed in accordance with the sizes.

It is hoped that all boys who are interested in model-building will make a point of building each of these special models. The Editor invites correspondence on the subject and at all times is pleased to answer questions regarding the construction and operation of any of the models. "If in doubt write to the '*M.M.*'"



X. Bombay, Second Largest City in the Empire. A Town in an Extinct Volcano. Parsee Towers of Silence. Port Said, Marseilles, Home Again!

MY railway journey across Rajputana brought me to the west coast of India and ended at Bombay. This wonderful place is the gateway of India, and among the cities of the British Empire it is now second to London only in regard to population and area. It is still growing in remarkable fashion. In the 10 years before the last census was taken the increase in population was no less than 200,000 and brought the total to 1,175,000. Only three-fifths of the number are Hindus, the rest being mainly Mohammedans, together with about 50,000 of a remarkable race of people known as Parsees.



The Hindus of Bombay cremate their dead on piles of wood as shown in this photograph

Bombay has not always been of such importance as it is to-day. Very little more than 250 years ago the island on which it stands was rented to the East India Company for the sum of £10 in gold per annum, and the total population was less than 10,000. It rose a little later to be the chief possession of the company in India, but the growth of Calcutta quite overshadowed it and it declined steadily until the middle of last century. The great revival that then took place is a testimony to the influence of railways. Calcutta had grown more quickly than Bombay because it was at the mouth of the Ganges, a large navigable river, and was within reach of the richest provinces of India. In addition, the journey from Great Britain to almost any place in India was much more comfortably accomplished by way of Calcutta than by Bombay, in spite of the longer sea journey. The coming of the railways, in conjunction with the building of the Suez Canal, altered this completely. The opening of the Canal made Bombay the natural point of arrival from Europe, while the railway lines spreading out in all directions from the city afforded an easy and convenient means of access to practically all parts of India.

One very noteworthy feature of the railways in their early days was the method adopted for climbing the steep hills that come so close to the western shore of the Indian peninsula. These are known as the Western Ghauts and must be surmounted by the lines that run east to central India and Calcutta, or south-east to Madras. The track was carried up the slopes by zig-zag inclines having gradients of as much as 1 in 37. On the line originally surveyed there was no room in which the trains could curve round in passing from one incline to the next, but this difficulty was overcome by providing reversing stations.

One of these is shown in the illustration at the head of this article. A train ascending the Ghaut reaches the reversing station by the incline on the right. The engine is then moved to the rear of the train in order to pull it up the next incline in the reverse direction. Thus the trains zigzag their way up the hillside, crossing great viaducts and plunging into numerous tunnels on their way from the sea level at Bombay to the height of the central Indian plateau. Two famous inclines that were ascended by this reversing method were the Bhore Ghaut and the Thull Ghaut.

Recently, the line to the east has been reconstructed to make it more suitable for the vast amount of traffic that now passes over it to and from Bombay. Some parts of the line have been straightened, although this involved the building of Parsik Tunnel, 4,300 ft. in length, the second longest tunnel in India. I thought that the entrance to this tunnel was very impressive indeed. A further improvement is the abolition of the reversing stations on the Thull Ghaut incline. The size of the stations restricted the length of the trains that ascended the incline, while much time was lost in carrying out the reversing operations. On careful examination it was found possible to carry the line up the Ghaut without reversing at all, while the gradient remained at an average of 1 in 37, and the much longer and heavier trains now desirable are taken up with ease by powerful locomotives.



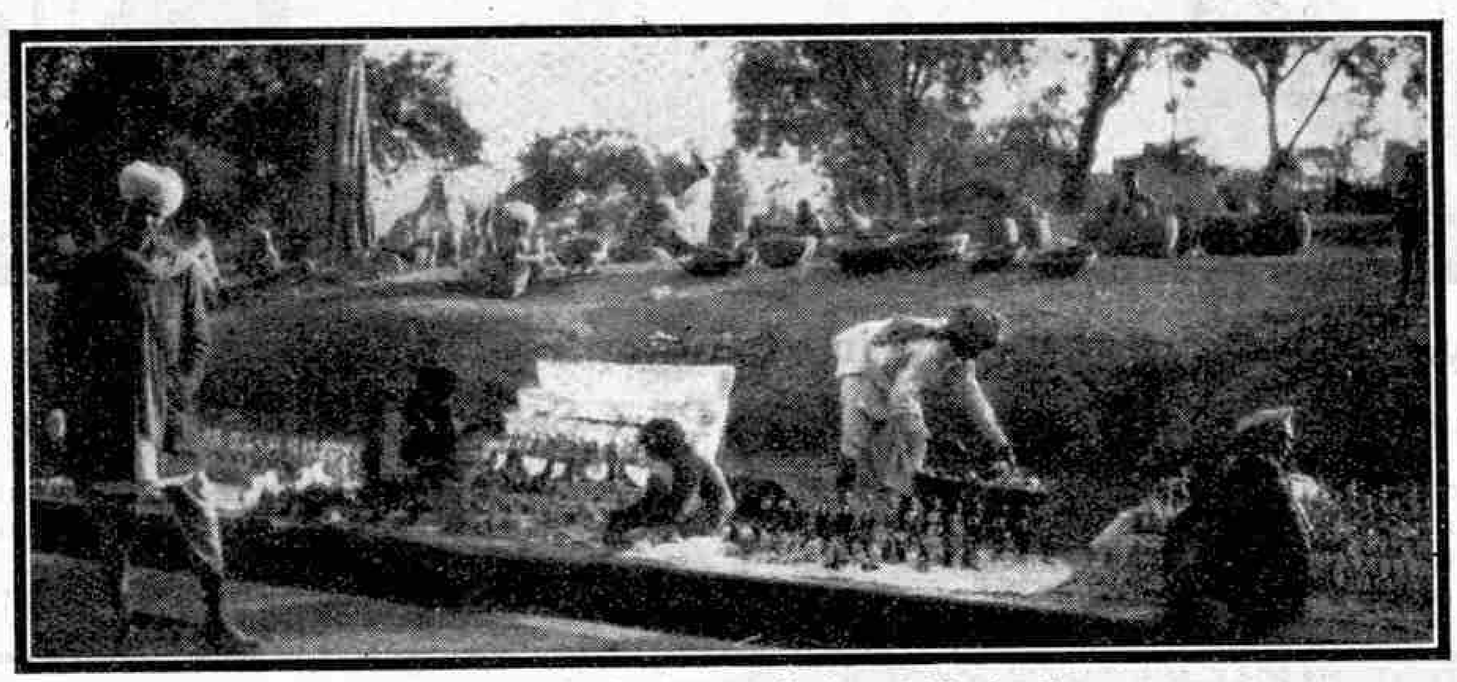
Hindu barber at work, Cawnpore. His shop is wherever his customer meets him!

I was shown a place on the line where at one time there was to be seen the remarkable spectacle of 21 miles of grain-laden wagons waiting to go forward. This was only a few years after the line was completed, and the huge assembly was not due to any breakdown on the railway, but to a terrible famine in the Madras district. While the people of this district were starving, splendid harvests had been gathered throughout the rest of India, and the railway officials performed prodigies in transporting food to Madras from the more fortunate districts.

It needs very little reflection to realise that the wonderful

engineering achievements of the British in India have been responsible for saving thousands of lives. The great irrigation schemes that have been carried out have transformed parched deserts into fertile areas, while the conservation of water has made the failure of the monsoon of less importance than it used to be. In addition the coming of the railway has made it possible for food to be rushed quickly into any area where there is a shortage.

Returning to Bombay, I had a wait of a few days before me, and I spent the time profitably in tours round the city, which I found to be of extraordinary variety. Owing to its situation and trading importance, Bombay is very cosmopolitan. All kinds of people are to be met with there, from Arab horse dealers, Persian merchants and Afghans to Negroes from Zanzibar, Malays and Chinese, in addition, of course, to Hindus.



Some of the interesting open-air toy stalls in Cawnpore

I was specially interested in the bazaar, as I had been in other Indian cities, for it is there that one best sees native manners and customs. The bazaar at Bombay is divided into sections, not in order to keep different trades apart, as in Great Britain, but to separate the people of different religions. I found it full of life and bustle, with shopkeepers and customers squatting on the floors of the open shops bargaining with each other. Potters were moulding vessels on their wheels; a slipper-maker was busily engaged next door to a butcher, who cut meat by drawing it across a knife held between his feet; while dyers and weavers, mat-makers, writers, long-haired fakirs, water-carriers and coolies went to make up a scene crowded with noise and colour.

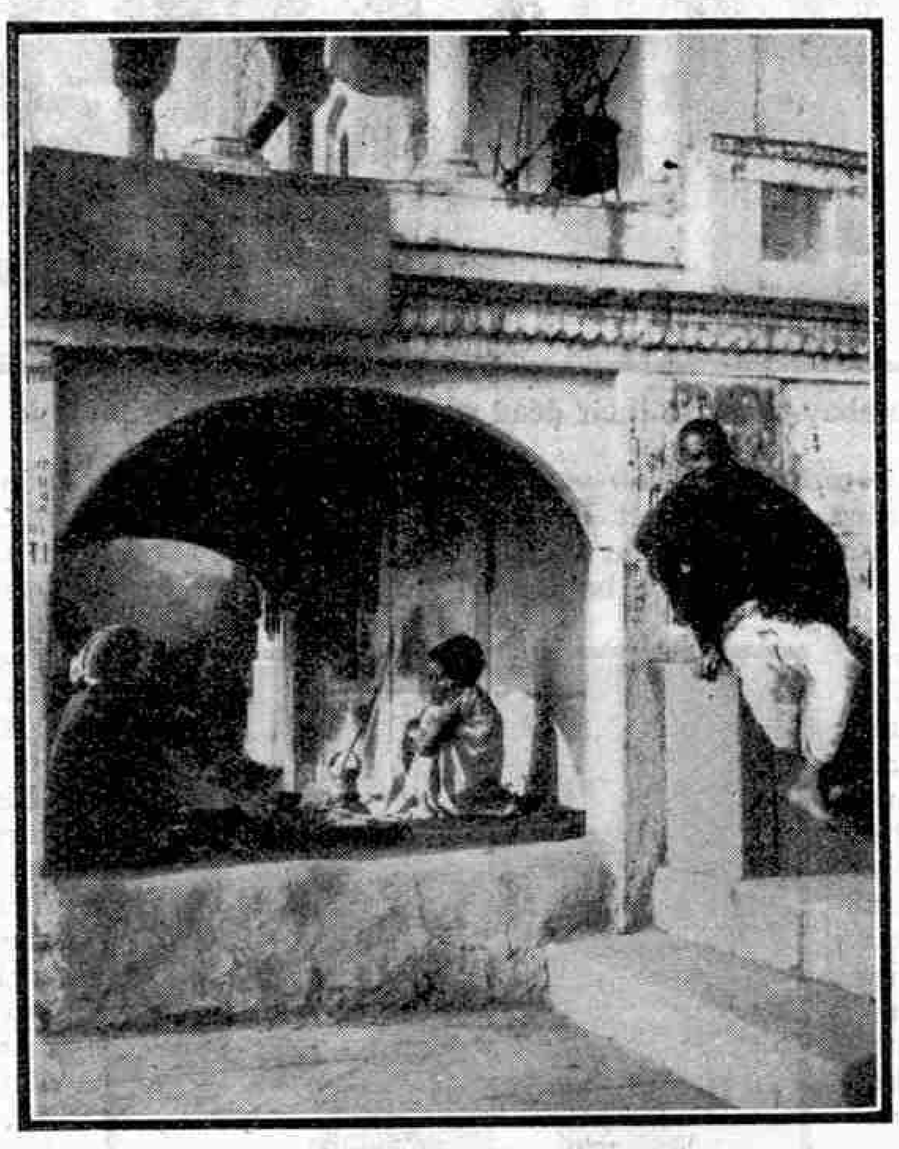
The attraction was further enhanced by the oriental attire of the people and the ostentatious ornaments of the women. Some of the latter may be seen walking along the road in their bare feet with silver ornaments attached to their toes, and silver and gold bangles around their ankles, wrists and necks. One feature that immediately strikes the eye of a European is that many of the women have large rings, often richly jewelled, fastened through the soft part of the nose.

The business quarters of Bombay contain many imposing buildings, while a European suburb has sprung up on the side of the island overlooking the Indian Ocean. The splendid harbour is on the landward side. It affords adequate protection to shipping and has been largely responsible for the rise of the city.

One of the most surprising things about Bombay is the existence of the colony of Parsees, or Persians, which I have already mentioned. These people still adhere to the old fire-worshipping religion of their ancestors, after 1,300 years of exile, and it is, in fact, their religion that is responsible for their presence in India to-day. The native country of their forefathers was conquered by Mohammedans, and under compulsion most of the inhabitants adopted the religion of the conquerors. Those who did not do so found it necessary to seek a new home. Sailing from the mouth of the Persian Gulf, the exiles underwent many hardships and had many exciting adventures before finally settling on the west coast of India. They retained their national character in the midst of the Hindus, and increased considerably in wealth and numbers, for they are shrewd merchants and traders.

Eventually they settled in Bombay, which they reached at about the same time as the British, and there they erected the first of the famous Towers of Silence that are now to be seen on the summit of the Malabar Hill, overlooking the Indian Ocean. I took the opportunity of paying a visit to one of these erections. Having obtained the necessary pass, I was taken by a guide as near as is permitted to strangers.

The towers are circular and roofless, the stone platform inside being open to the sky. They are the buildings in which the Parsees dispose of their dead. No funeral ceremony took place while I was there, but I was informed that, after the necessary religious rites have been completed, the body is taken inside one of the towers by professional corpse bearers, the mourners remaining a short distance away. It is carried on an iron bier and is laid in one of many shallow receptacles arranged in three circular rows on the floor. The clothes are then removed in order that the vultures that abound in the neighbourhood may be attracted, the cotton sheets in which the body has been wrapped being thrown into a pit and destroyed by pouring sulphuric acid on them. The vultures quickly devour every particle of flesh, leaving only the bones for disposal. These are dried by the sun and are removed from the platform into a central well, where they gradually crumble to dust. Rainwater washes the dust into underground drains so that every trace of the body finally disappears.



A typical shop in an Indian Bazaar

The Parsees claim that this manner of disposal of the dead is by far the most sanitary. Their strange funeral rites are perhaps the best known of their customs, but it is well to remember that they are very devout people and that their religion is at least 3,000 years old. They believe in God, and reverence the Sun, the Moon, the stars, the mountains, the rivers and above all fire, as manifestations and symbols of the omnipotence of the Creator. Even their towers are made symbolic. Of the three circular rows of receptacles for bodies in the interiors of the towers, one is reserved for men and the others for women and children. These correspond with the three chief requirements of their religion—good deeds, good work, good thoughts.

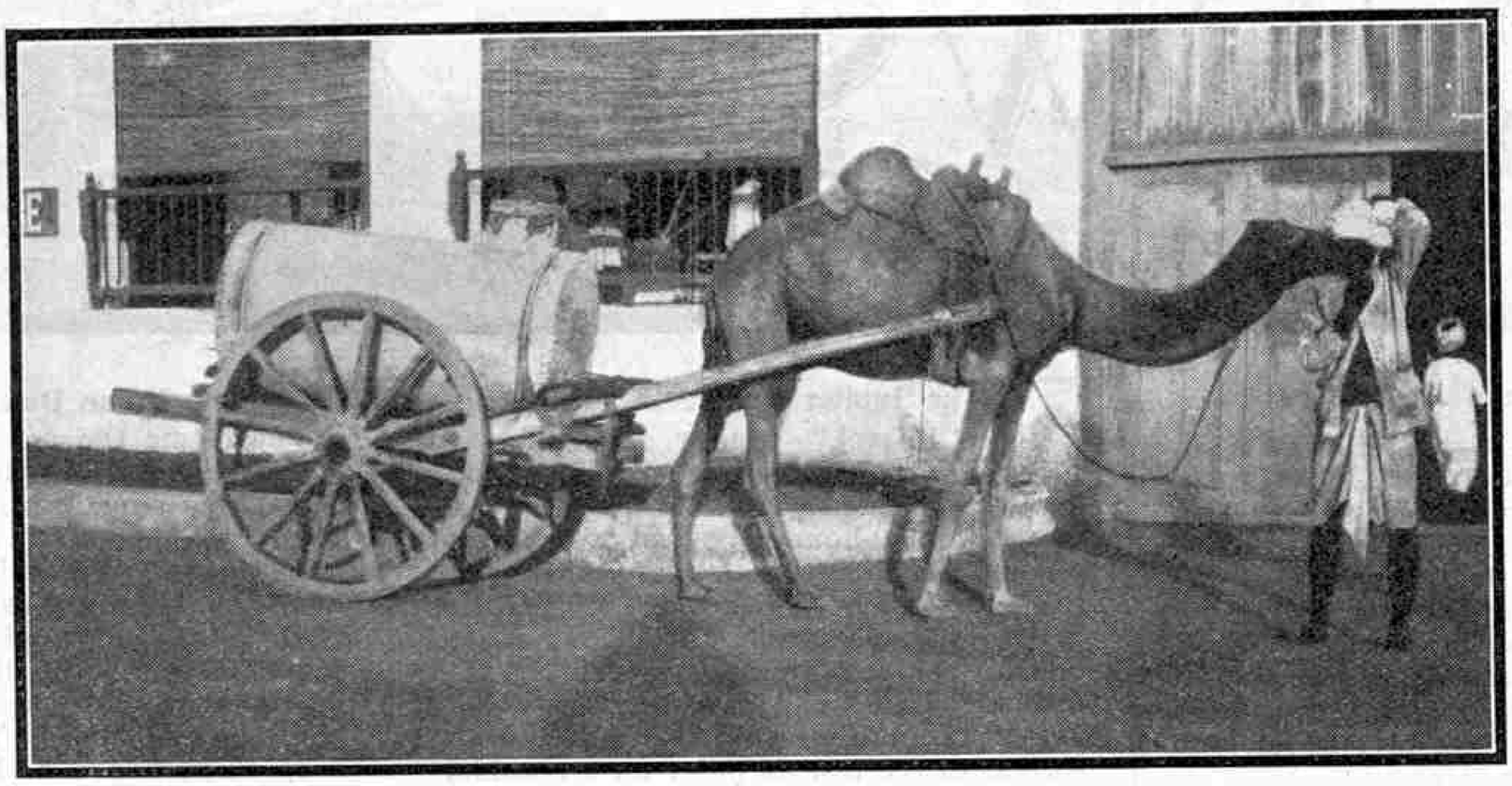
All too soon the time arrived for me to embark on the last stage of my journey round the world. In a splendidly appointed boat I left Bombay for Europe, and an uneventful run of four days brought me to Aden, the solitary but important British station on the south coast of Arabia.

Aden is on a peninsula connected with the mainland by a neck of sandy ground only a few feet in height. The peninsula itself is a mass of barren and desolate rock of volcanic origin and the town is situated in what appears to be the crater of an extinct volcano. There is no difficulty in realising that the peninsula is an ancient volcanic mass, for the rock of which it is composed has a distinctly cinder-like appearance.

The great importance of Aden to us is, of course, its value as a coaling station. Harbours on the Arabian coast, particularly on the west, are very scarce, and Aden offers practically the only opportunity for shelter and for obtaining supplies between Suez and India. This was realised centuries ago, when the harbour was used by the Romans, and its advantageous position made it one of the chief marts of Asiatic produce throughout the middle ages. Its trade suffered greatly when the sea route round the Cape of Good Hope between Europe and India was discovered, but the construction of the Suez Canal made it more important than ever, and since its occupation by the British almost 90 years

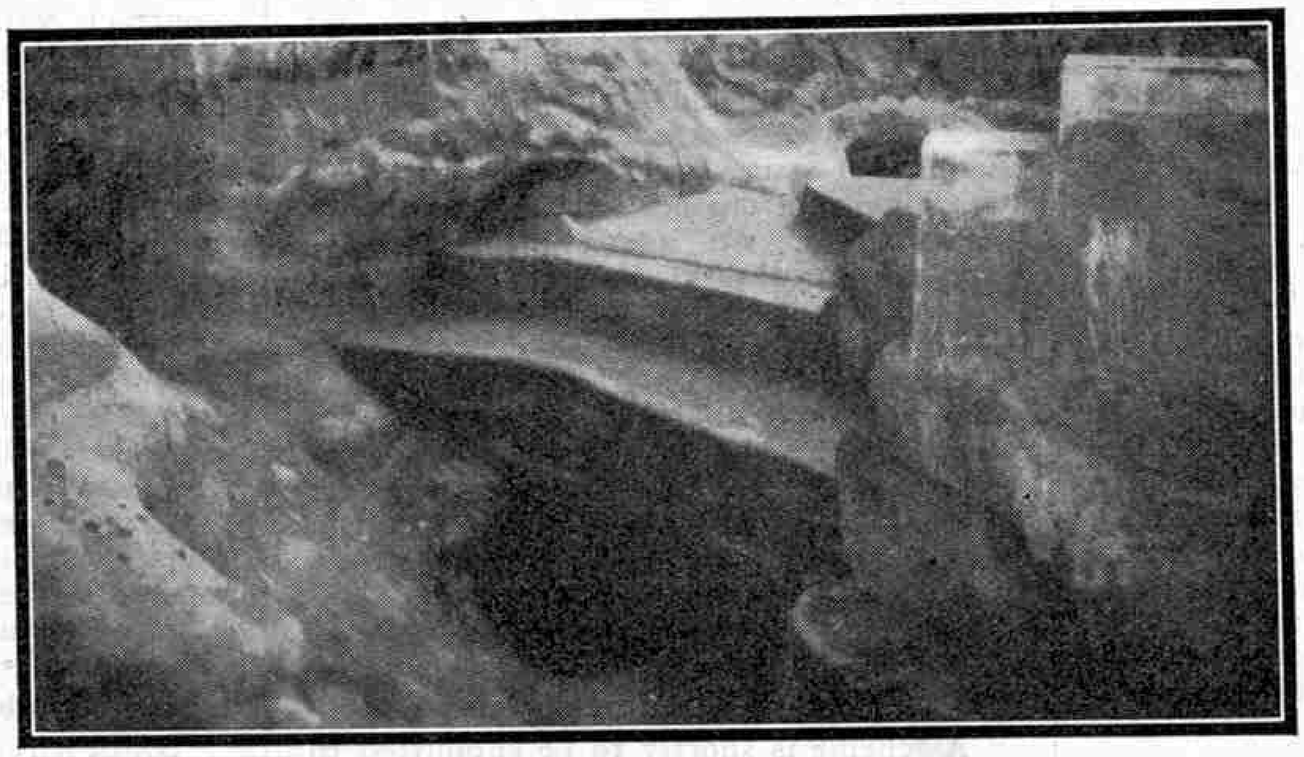
ago the population has risen from 1,000 to considerably more than 50,000, a remarkable increase in so short a time.

One of the greatest difficulties of life at Aden is the lack of water. Besides possessing a very hot climate, Arabia is one of the driest parts of the earth, and in order to combat the shortage that often threatened, a magnificent system of cisterns to collect rain-water was constructed in the rock in the palmy days of the port some centuries ago. These fell into disrepair later, but now have been partly restored so that some of the tanks are once again serviceable. While at Aden I took the opportunity of visiting these world-famous tanks and was greatly impressed by their extent. The present needs of the town are partly supplied from them, distillation of sea-water and wells sunk to a depth of from 120 ft. to 190 ft. in the solid rock being the other sources at present available. Water is a very valuable commodity in Aden and must be paid for.



A water-cart at Aden distributing the precious liquid

If time had permitted I should very much have liked to travel into what is generally described as the hinterland of Aden. Contrary to general opinion, the country at the back of Aden is in parts extremely fertile and well suited for grain such as millet, while it has long been famous for dates and coffee. The great central desert of Arabia does exist, of course, and large portions of the arid sandy waste have not yet been explored, but oases and very considerable stretches of cultivated country intervene, and there is a comparatively large population. No doubt the introduction of modern machinery will enable the natural resources of the country to be developed still further. The motor car has already penetrated into places where for ages camels and donkeys have provided the only means of transport, and it is worth note that the palace of the Sultan of Lahej, a state whose rulers once possessed Aden, is now electrically lighted by a generating plant that derives its power from a modern two-stroke heavy oil engine of British make.



Cisterns cut in the solid rock at Aden, centuries ago, for the storage of rain-water

Leaving Aden, a run of 100 miles brought us to the narrow strait through which the Red Sea is entered. At the entrance, which is only 20 miles in width, stands the island of Perim, which must surely be one of the dreariest of British possessions, for it seems to be a barren rock with only a lighthouse and a tiny settlement on it. We passed by and entered the Red Sea in expectation of three days of almost unendurable heat. Our expectations were fulfilled, for the stillness of the air and a general clamminess made things very uncomfortable indeed. The nights were very little better than the days, and it was with distinct relief that we arrived at Suez.

The rest of the journey was over ground that will be more familiar to "*M.M.*" readers. The boat proceeded slowly north through the canal, with a wilderness of yellow sand on either side. The passage through the narrow stream in a large ocean-going liner is remarkable, but somewhat monotonous, and it was quite a relief when we found ourselves on the wider expanse of the great Bitter Lake. On arrival at Port Said I went ashore for a short time. I have often commented on the variety of races represented in the ports of the East, but the climax was reached at Port Said, where every race under the Sun must surely be represented, not by single individuals only but by comparatively large groups. The constant appeals of beggars and would-be guides made it quite a relief to return to the boat.

Soon after our departure from Port Said I looked back, to find that it presented the appearance of a row of houses rising from the sea itself. There were no cliffs or, in fact, any visible indication whatever of a coast-line. Still more surprisingly, a lighthouse and some black patches appeared on the horizon on our left long after Port Said had completely disappeared from view. As we approached more closely the black patches resolved themselves into houses, mosques and palms. This was Damietta. The apparent isolation of this town and Port Said is due to the fact that the land in the northern portion of the Nile Delta is absolutely flat, while between them lies a large salt-water lake separated from the open sea by narrow mud flats only. To a traveller by water, therefore, Damietta, which is 40 miles from Port Said, looks like a detached fragment of land.

On losing sight of Damietta a pleasant voyage under blue skies across the Mediterranean Sea followed. In the course of the voyage a glimpse of the island of Crete was obtained. This island presented a striking contrast to the land we had left, for steep cliffs arose from the sea, and inland a range of mountains with snow-covered peaks was very clearly visible.

To me the most interesting and remarkable sight during the passage from Port Said was the active volcano Stromboli. The island of this name is one of a group situated north of Sicily. There are seven islands altogether, together with 10 islets, some of them mere rocks, that are the remains of a great central volcano now submerged. Stromboli itself is a cone that rises to a height of 3,022 ft. above sea-level and is the only example in Europe of a continuously active volcano. Seen from a distance at night it appears as a red dot on the horizon, but on passing it more closely puffs of flame and smoke can be distinguished rising above the cascade of red-hot lava.

The voyage came to an end at the busy port of Marseilles, where I left the boat to travel overland to Calais. A short run across the channel to Dover followed, and my wonderful tour was over.

I cannot imagine anything more interesting than the glimpses I obtained in travelling round the world of the many different types of people and of the wonderful way in which man has adapted himself to the varying conditions under which he lives. The industry of the pleasant little Japanese folk, the pathos of life on the crowded river at Canton, the simplicity of the native villages in the wonderful island of Java and the extraordinary complexity and antiquity of the manners and customs of the millions living in British India—these and many other pictures will remain long in my memory, and I have no hesitation in recommending a tour similar to my own to anyone who is able to undertake it.



London to Paris Air Record

Flying a Handley-Page Jupiter air liner, weighing seven tons, Captain A. S. Wilcockson, of Imperial Airways, recently flew from London to Paris in a total flying time of 90 minutes, a record for a machine of this size. The average speed was 150 miles an hour. The Handley-Page Jupiter is the most powerful air liner on the London-Continental services, and is fitted with three Bristol Jupiter engines, developing nearly 1,500 horse-power.

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Australian Air Service's Fine Record

The record of the Australian Aerial Services Limited is a very fine one. From 1924 up to November last over 500,000 miles had been flown without an accident of any description, and during this period over 7,800 passengers were carried. The company commenced with a fleet of three machines. It now has 11, and passenger and mail services are operated between Melbourne and Hay, Cootamundra-Hay, Mildura-Adelaide and Mildura-Broken Hill. Two of the company's pilots have flown over 100,000 miles each, their joint mileage being equivalent to a flight from the Earth to the Moon!

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Air Survey of Iraq

The Aircraft Operating Company have commenced an air survey in the neighbourhood of Baghdad. Approximately 1,000 square miles are to be covered, the object of the survey being to secure maps preliminary to the opening up of pump irrigation works designed to bring the area into cultivation once more. A photograph map on a scale of 6½ in. to the mile will be prepared, and it is hoped that many unsuspected features will be revealed, such as the presence of oil deposits and location of interesting archæological features.

The company have sent out an entirely new expedition to take over this work, in the belief that further contracts will be secured to justify the establishment of the expedition on a permanent basis, covering Iraq, India and the remaining parts of the near and middle East. There is enormous scope for further work.

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The Persian Government have concluded an agreement with the Soviet Government for co-operation in the air post service between the two countries. Persia is negotiating also with the German Junkers Company for the establishment of an air route between Teheran, Bushire and Mohammerah.

The Jupiter Engine in Japan

The "Bristol" Jupiter engine is now being constructed under licence in Japan by the Nakashima Aircraft Company and recently a 50-hour type test was carried out on the first engine completed, under the supervision of inspectors of the Imperial Japanese Navy. At the conclusion of the test the engine was stripped and examined and found to be in every way in perfect condition. As a result of the success of the test an order for a considerable number of these engines has been placed by the Japanese Navy.

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London's New Air Port

Although nominally the new air port at Croydon is not to be opened until the early summer, certain of the new buildings have actually been in use for some three months. Three of the large hangars, measuring 150 ft. in width by 300 ft. in length, are in service, two of them being used by Imperial Airways machines and the other by machines of the Continental lines. At the rear of each hangar there are stores with offices above.

A series of workshops for the manufacture of spare parts and the repair of machines and engines is still in course of construction. An interesting feature of the new workshop accommodation will be the installation of a specially-designed engine-testing plant, which is to be employed for giving final tests to the five different types of aero engines that are now employed in Imperial Airways machines, before they are passed for service. The old control tower is still in use and will continue so until the new tower has been fitted with its direction-finding equipment.

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Spanish Air Developments

A scheme is shortly to be submitted to the Spanish Government under which provision is made for the setting up of a big network of air routes to link up Madrid and the provincial cities with outside countries.

It is proposed to open up three principal routes and tenders are being invited for the contract. An annual subsidy of approximately £50,000 is proposed to be paid, but it is a condition that the whole of the share capital of the company taking up the contract must be Spanish, while 90 per cent. of the operating personnel must be Spaniards. The scheme also provides for the existing airlines to be taken over and operated by the same company as that undertaking the new lines when the present contracts expire.

New Home Defence Squadrons

The Home Defence Air Force is shortly to be enlarged by the creation of three new flying squadrons. Two of these will be night bombers, one of which was formed at Oxford in the early part of the year, and is to be known as No. 10. The other is to be No. 101 and is being formed at Eastchurch. Both these squadrons will be equipped with the latest type of night bombing machines. The third squadron is to be stationed at Hucknall, near Nottingham, and will be equipped with daylight bombers.

* * * *

Ship to Shore Mail Contract

Following the experiments in landing air mails from inward-bound steamers off Father Point in the River St. Lawrence, which have been successful, the Canadian Government have placed a contract for an all-the-year-round service with the Canadian Trans-Continental Airways Limited, of Quebec. The machines engaged on the contract will maintain regular services between various Canadian cities and the trans-Atlantic mail boats at Father Point. Fairchild monoplanes fitted with 425 h.p. Pratt and Whitney-Wasp engines are to be used.

* * * *

Air Ministry Flying Boats

The Air Ministry have placed an order with the Blackburn Aeroplane and Motor Company for three Blackburn Rolls-Royce flying boats. Details are not available, but it is understood that the new craft will be similar to the "*Iris II*" that was launched at Brough last August. This machine was described as the largest flying warship in the world, and it can remain in the air for at least 14 hours. It is of all-metal construction.

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Durban-Rand Air Service

South African readers particularly will be interested in the announcement that a detailed project for an air service between Durban and the Rand has been prepared and submitted to the Union Government. It is proposed to operate the service with three D.H. 61 type machines, similar to the "*Canberra*" that was built specially for overseas work and recently despatched to Australia. These machines would be able to cover the distance in 3½ hours, and a double daily service in each direction is to be maintained. Limited passenger accommodation will be available. The proposers of the scheme state that it cannot be undertaken at present unless the Government are prepared to grant a subsidy of £8,000 per annum for the first two or three years' working.

Air Survey of Rio de Janeiro

The Aircraft Operating Company, the British air survey firm, announce that their tender for what is by far the biggest and most important contract yet let in air survey has been accepted in the face of severe international competition. The contract is for a survey of Rio de Janeiro and the Federal District, covering an area of 450 square miles.

The chief interest of the work lies in the large scale on which the area will be mapped. The largest maps will show 63 inches to the mile. This is the first time that so large a scale has been used for mapping a large area, and the contract marks a definite forward step in the development of aerial survey. To map the area by normal ground methods would take twelve years, but by using a combination of air and ground methods the company have undertaken to complete the work in three and a half years.

A special type of survey aeroplane is now under construction. This differs radically from the commercial transport type. It will be equipped with two powerful air-cooled radial engines with geared propellers, and with normal survey load, consisting of pilot, photographer, gear, and 240 gallons of fuel, the ceiling with two engines will be 23,000 ft. The cruising speed at 20,000 ft. is estimated at 110 m.p.h. and the range at that speed is 7½ hours. Such a machine at first sight might seem uneconomic. In point of fact it will effect a saving in capital and maintenance charges by doing away with the costly chain of emergency landing grounds hitherto necessary, and by making practicable a survey over an area where it might be impossible to establish landing grounds within sufficient radius of the centre of operations.

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Attempt on Duration Record Fails

Flying their Fokker F.D.VII "*Southern Cross*," fitted with three Wright-Whirlwind engines, Mr. Kingsford Smith and Mr. G. R. Pond recently made an attempt to beat the world's duration of flight record. The machine took off with 1,440 gallons of petrol and 44 gallons of oil aboard, but after ten hours' flight the aviators reported by wireless to the aerodrome below that their fuel consumption was proving heavier than had been anticipated. Finally the machine was forced to land through shortage of fuel after flying for 48 hrs. 27 mins., some four hours short of the existing record.

From England to "Down Under"



Photo] [*A. V. Roe & Co. Ltd.*

Our photograph shows Mr. Bert Hinkler and the Avian machine in which he accomplished the wonderful solo flight to Australia that was described in last month's Air News. The photograph was taken immediately prior to the commencement of the flight and Mr. Hinkler is the central figure. Mr. R. Chadwick, the designer of the Avian, is seen on Mr. Hinkler's left.

As a matter of secondary interest, an excellent idea of the size of an aeroplane hangar is secured by comparing the sizes of the man and the hangar door in the background on the right of the picture.

Air Port on River Mud

To meet the necessity created by the establishment of an air mail service along the Western American coast, the city of Portland, Oregon, is to build a new air port on Swan Island.

Behind this simple announcement lies an interesting story of a clever piece of engineering. Swan Island lies in the centre of the Wilametta river at Portland, and its situation has created a constant menace to shipping owing to the diversion of the flow of the river into two tortuous channels. In order to improve the river facilities the port authority some time ago decided to remove the island by means of powerful suction dredgers, to permit the straightening of the river channel. As the work progressed it became clear that it would not be necessary to remove the whole island. The plans were altered to meet the new situation and it was decided to dredge only that portion of the island away from the new channel, and to pump the soil across to the side adjoining the ship channel. In other words it was merely a matter of removing soil from one part of the river bed and dumping it in another. Originally the intention was to use the remaining portion of the island as a warehousing site but the need for a central air port was more urgent.

The new port is built 5 ft. above high water mark and is 6,000 ft. in length and 1,224 ft. in width. Fortunately, the longer direction lies parallel with the prevailing winds. A causeway built from the island to the mainland will provide a runway 5,000 ft. in length at an angle of 45° to the prevailing winds, and thus a perfect take-off into any wind is available.

Aeroplanes Swell Tax Receipts

One would hardly link up aeroplanes with tax-collectors, but in truth they have proved very valuable collaborators. In all parts of the world land tax assessments are based mainly on the area and accessibility of the land, and the accuracy of the assessment depends upon the accuracy with which the land to be taxed is mapped.

One such case arose in an out-of-the-way district in America. The owner of a certain estate—which he fondly imagined was unmapped—objected to his assessment, representing that his estate was absolutely inaccessible and had no recognised route of communication with the outside world. The authorities held a trump card, however. An aerial photograph not only disclosed a fair-sized stream running through the estate, but also showed the proximity of a comparatively good road. The owner paid up, and nowadays he has a great respect for aeroplanes and cameras!

Similar disputes often used to occur in India in connection with the periodical settlement surveys. Naturally each villager wanted his settlement area to be mapped as smaller than its actual area, and bribery was rife. The necessity for surveying the Irrawaddy Delta in Burma arose some three or four years ago. Working from the ground, years would have been occupied in the task even by a large party. This was out of the question, and the then Surveyor-General of India decided to employ an aeroplane. The work was done in four months, without the inhabitants having the slightest inkling of what was taking place!

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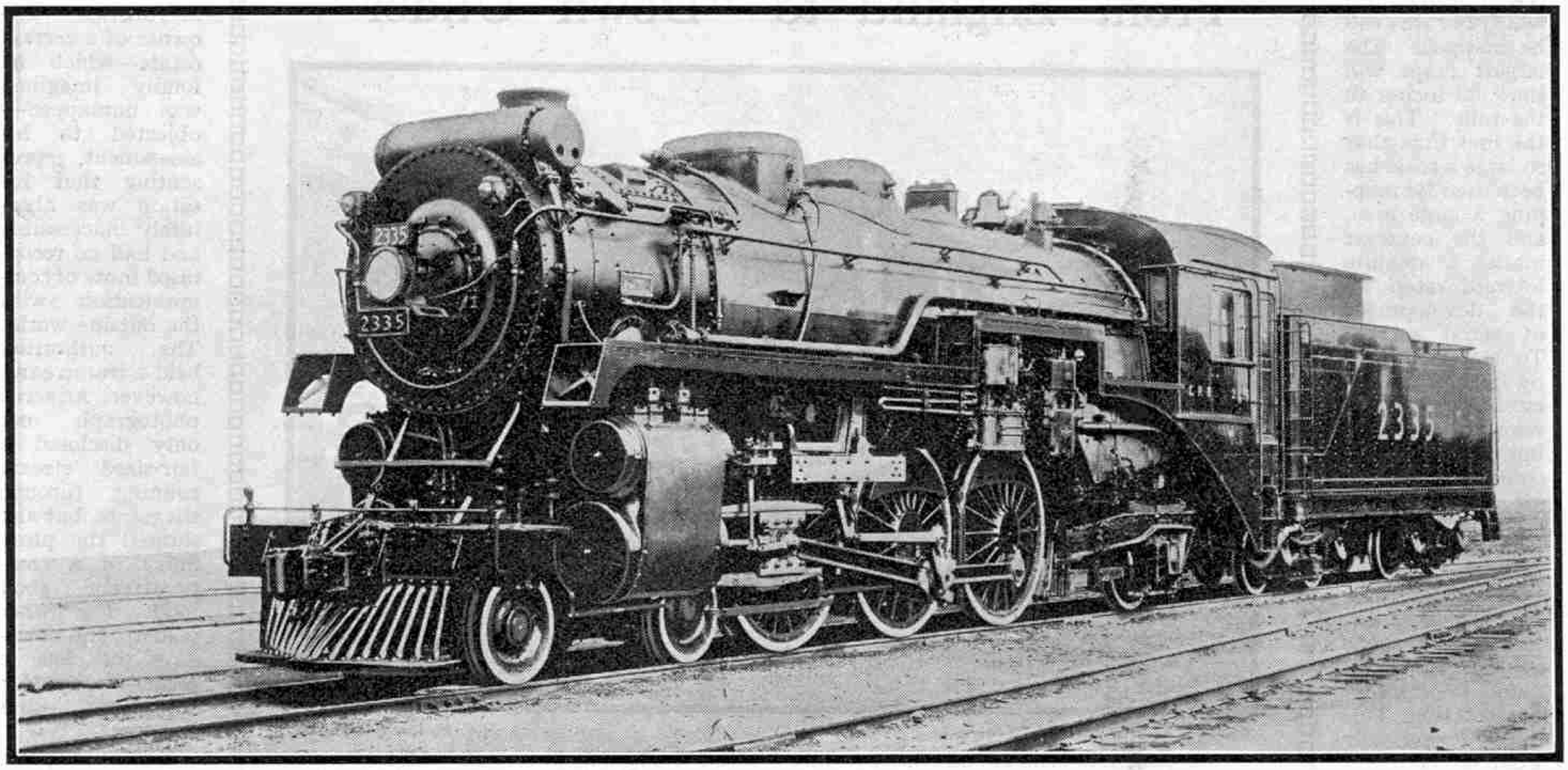
United States Air Services

The allocations for air services for the 1928-9 period were recently presented to the United States Congress and in every case an increase over the amounts allocated last year is shown. The principal increases are in respect of the Army Air Corps, the Navy Bureau of Aeronautics, and the Post Office Department. The principal increase in the Army Air Corps vote is for the purpose of new aircraft and equipment, on which a sum amounting to over 2½ million pounds is to be spent. Included in the Naval vote is a sum of £350,000 toward the building of a rigid airship, the total cost of which is to be not more than £900,000.

FAMOUS TRAINS: XVII.

"*Trans-Canada Ltd.*" Canadian Pacific Railway

By Cecil J. Allen, M.Inst.T., etc.



Latest "Pacific" type express locomotive, Canadian Pacific Railway

ON our journey this month you will need to bring with you your night-clothes and a suit-case—or "grip," as it is tersely described in the country we are about to visit—for we shall spend the best part of a week in the train. Incidentally, before the journey begins we have to cross the sea, and in this connection it is interesting to note that the railway that is to act as our host for our four days and a half in the train can also carry us across the Atlantic in its own magnificent liners, and if we are not content with that, can meet us with a steamer at the other end of the railway journey to run us on over the Pacific to Japan. The Canadian Pacific goes nearer to girdling the world than any other railway company in existence.

We must imagine, therefore, that we have crossed the Atlantic, and that our Canadian Pacific liner has taken us right up the long estuary of the River St. Lawrence—the winter ice having melted by now—and deposited us at the thriving city of Montreal. This, the largest and most populous city in Canada, is to be the commencement of our continuous railway journey of 2,886 miles to Vancouver, right across the continent of North America. Over Montreal itself we can spend no time, as we shall need all the space at our disposal in order to describe the unbroken day-and-night running of the "*Trans-Canada Limited.*" Shortly after tea one Monday evening, therefore, we make our way to the palatial Windsor Street Station of the C.P.R., to make our first acquaintance with a Canadian train.

In many ways we shall find the railways across the water totally different from our own. The first difference that is apparent is in regard to the station itself. In Great Britain the passenger usually spends as much of his time on the station platform as he does in the station buildings, and very often more. But in the North American continent the temperature through many months of the winter is so low that such a proceeding is not possible. Consequently the main terminal station interiors are usually planned on very palatial lines, with magnificent waiting-rooms and other accommodation for the comfort of the passengers, who only make use of the platforms for the purpose of walking to and from their trains. The trains themselves use what is called the "train-shed," which well deserves its name; the narrow platforms are raised very slightly above the ground level, and are really little more than footpaths.

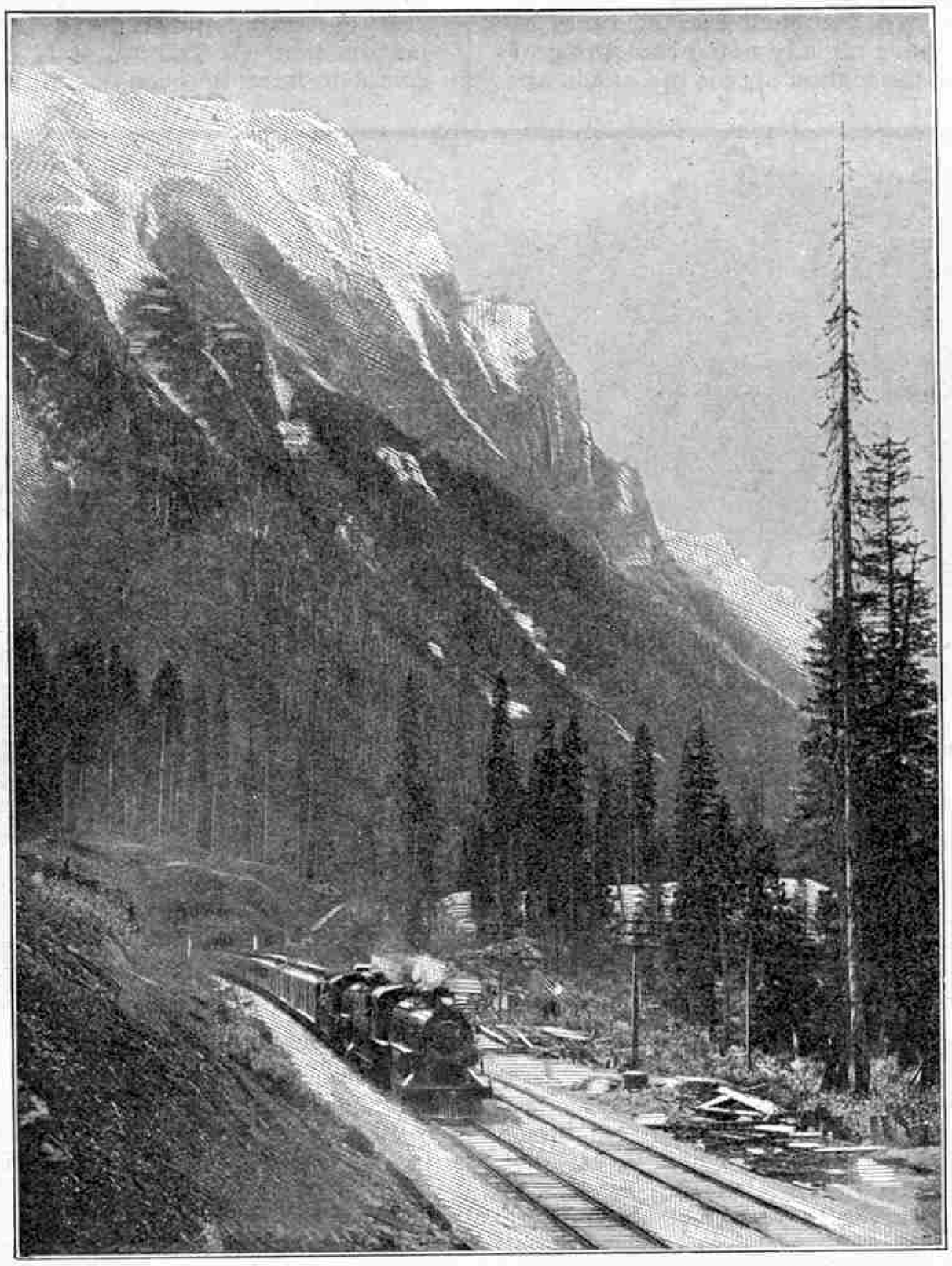
Probably we have already in our possession the generous printed sheets of paper that serve for our

Leading Dimensions of 4-6-2 Express Locomotive No. 2335, Canadian Pacific Railway

Cylinders—Diameter	23 in.
„ Stroke	30 in.
Driving Wheels: Diameter	6 ft. 3 in.
Heating Surface: tubes and flues	2,981 sq. ft.
„ „ firebox	291 „
„ „ superheater	864 „
„ „ total	4,136 „
Firegrate Area	65 sq. ft.
Working Steam Pressure	250 lb. per sq. in.
Tractive Effort (at 85 per cent. working pressure)	44,965 lb.
Adhesion Weight	72¼ tons
Total Weight of Engine (in working order)	136¾ „
Total Weight of Engine and Tender ...	222¼ „
Water Capacity of Tender	9,600 gallons
Coal Capacity of Tender	12 tons

railway tickets; the only thing remaining therefore is to "check" our baggage. Here our Transatlantic friends are more advanced than we are in this country. At a small fee all our luggage is checked through to our destination. If we are going to an hotel at Vancouver we shall not see our effects, other than those we require for the journey, until, at its conclusion, we find them in our hotel bedroom. There will be no scrambling round the luggage van at the terminus in an endeavour to recover our bags and suit-cases from a great pile of baggage that has just been discharged from its interior.

Somewhere about half-past six in the evening, therefore, we pass through from the waiting-hall to the train-shed, to the platform at which we find standing the "*Trans-Canada Limited.*" The first and most immediate impression here is the vast size of American rolling-stock. I use the word "American," by the way, as describing generally what is found on the railways of the North American continent, which in every respect, whether found in Canada or the United States, are very similar in their methods and their equipment. As regards size, we must first remember that we are looking at the train practically from ground level, instead of having some three or four feet of its height foreshortened by the average British railway platform.



"*Trans-Canada Limited*" leaving the great Connaught Tunnel

Apart from that, Canada and the United States have profited by our early experience in railway construction and, aided by the comparative absence of overline bridges—for in the vast majority of cases the railways cross the roads, and even other railway lines, by "grade" crossings on the level—they have been far-sighted enough to leave considerably more room round their tracks than we have. The maximum height that a British locomotive designer has available in which to build a locomotive is, in the best circumstances, 13 ft. 6 in. above rail. In America 16 ft. is the more general figure, and although the gauge, or distance between the rails, is just the same as our 4 ft. 8½ in., the tracks are sufficiently far apart to allow of considerably greater width of rolling stock than is possible in this country. As a consequence, the largest American locomotives are more than twice the weight, size and power of the biggest yet built to run over British metals.

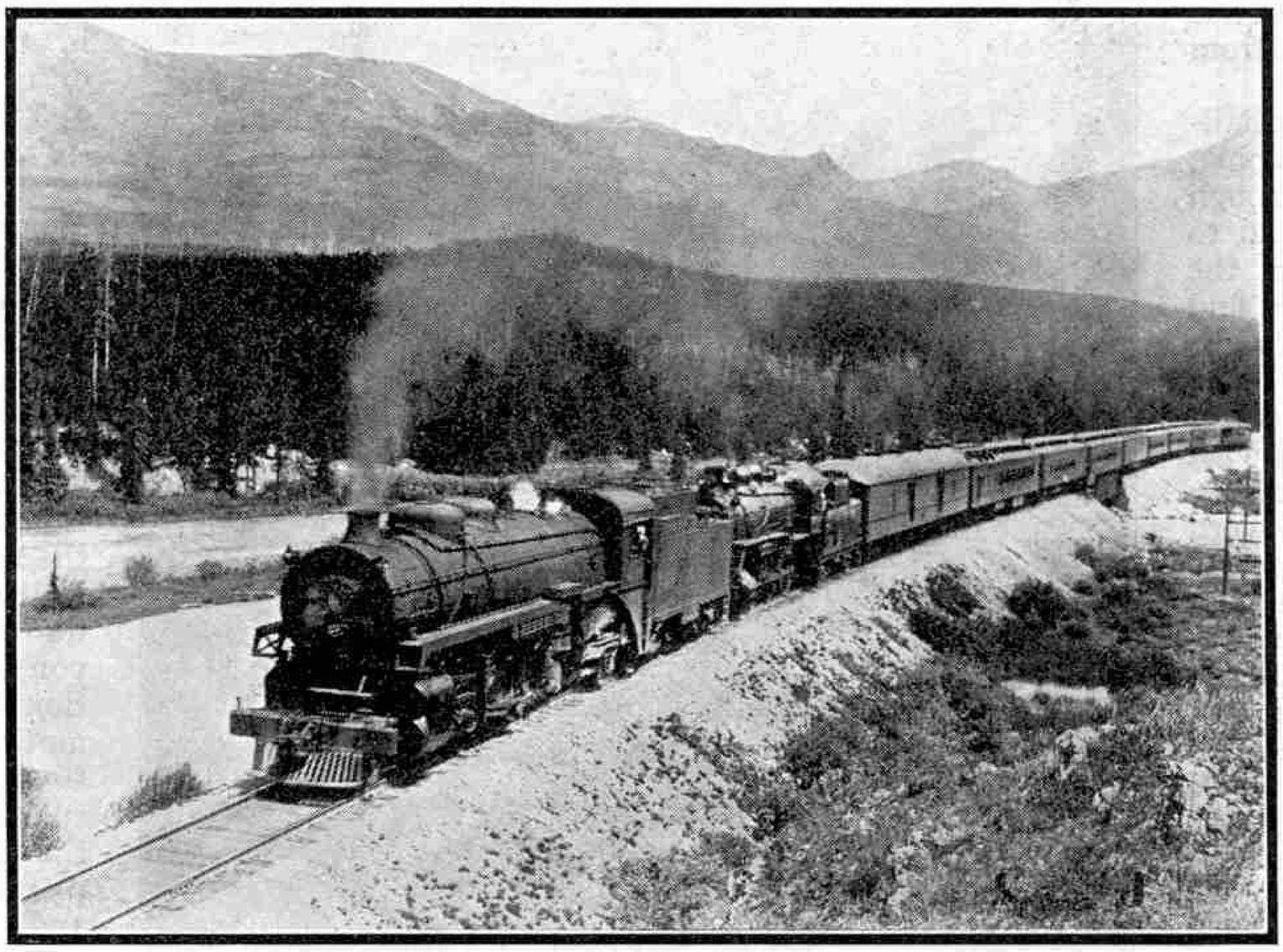
The same remarks apply to the rolling stock of which the trains are composed. Main line carriages in Canada and the United States are almost invariably carried on six-wheeled bogies and are enormously heavy. By reason of very solid all-steel construction, weights of 70 and 80 tons per Pullman vehicle are by no means uncommon, even when the length of the coach concerned is no more than 75 or 80 ft., or little more than that of the longest British main line rolling stock. Thus it is that a dozen of such Canadian vehicles can without difficulty make up a total train-weight of nearly a thousand tons, or again twice as much as that of the heaviest British express.

Before taking our places in the train we must, of course, have a look at the engine. The "*Trans-Canada Limited*" is to be hauled out of Montreal by a big C.P.R. "Pacific," which from ground level appears to us quite colossal. To British eyes many of its details are unfamiliar. As regards construction, an important departure from British methods is in the use of "bar" frames instead of "plate" frames. The frames, as you know, are the foundation on which a locomotive is built. In Great Britain these are cut from steel plate, and the two frames, located just behind the wheels and transferring the weight of the superstructure of the engine on to the axle-boxes, are set up on edge and strongly cross-braced in order to preserve their correct distance from each other. In America the frames consist of a lattice-work of steel bars, now usually fabricated in convenient sections of cast steel.

"Splashers" covering the upper part of the driving wheels are unknown. The running-board is lifted high above the coupled wheels, and the increased width of the engine allows of the arrangement of doors in the front of the cab, on both sides of the engine, through which the driver can pass to the front end, if need be. Reminders of the fact that railways in America are for the most part unfenced are seen in the huge headlight of the locomotive, designed to throw a beam of light far ahead at night, so that the engine-driver—I beg his pardon, "engineer," as he is known across the water—may have a chance of spotting any possible obstructions on the line. For the same reason there is provided in front of the buffer-beam the steel framework known as a "cow-catcher," designed to throw off the line, with a minimum of damage, any animals that may have had the temerity to venture on the track. Then there is also the great bell on the top of the boiler, which we shall hear tolling dismally as we pursue our way, at a funereal

pace, along the streets of the towns through which we pass.

And now we make our way back to our coach, as the departure hour of 6.45 p.m. is close at hand. Punctual to time we are off on our three-hour run to Ottawa, the capital city of Canada. For many reasons we need not expect any high speeds of note on this journey. In the first place, the route over which we are to pass is largely single line. Numerous stops have to be made *en route*, as over the wide-spreading spaces of a continent it is not possible to run express trains of the frequency to which we are accustomed. Over many parts of our route, indeed, not more than three or four passenger trains, both fast and slow, are worked in each direction daily. Gradients, too, we shall find at times to be very long and heavy, and we have already noted something of the weight of our train. Actually the highest speeds in Canada are made over the double-track main route between Montreal and the sister city of Toronto, rather over 300 miles apart, where the Canadian Pacific and Canadian National railways are in fierce competition with each other. Here average start-to-stop speeds of over 50 miles an hour are common, and the running is the more thrilling in that the competing trains are often, over certain sections of their journeys, within sight of each other.



"*Trans-Canada Limited*" climbing the Rockies, double-headed

So it is that a three-hour run over the 112-mile route to Ottawa only involves an average speed of just over 37 m.p.h., and except for one short stretch of line west of Winnipeg, the start-to-stop speeds will not exceed 40 m.p.h. on any stretch of the journey. For the whole distance of 2,886 miles we require 88¼ hours—including two hours by which we have to set our watches back while crossing Canada—which represents an overall average of only 32.7 m.p.h. But between 4½ and 5 hours of the running time are spent at the intermediate halting places.

From Montreal we run for a little way in a south-westerly direction to Vaudreuil, this main line being used also by the trains for the Toronto direction, and having the competing Canadian National tracks but a short distance away. Then at Vaudreuil we proceed in a more northerly direction up the valley of the Ottawa River, heading for the capital, and running over single line from Vaudreuil onward. During this run we have our first experience of dining on an American train, and very likely we are astonished at the lavish character of the fare provided. It is also somewhat of a surprise, no doubt, that instead of a *table d'hote* meal of the kind to which we are accustomed over here, the Canadian service is *a la carte*, so that we can choose more or less what we like. We are going to see a great deal of this dining car and its staff, as they will accompany us throughout the journey.

The first stage to Ottawa soon passes, and at 10 p.m. we are off again to the west. It now occurs to us that the time will soon come for "turning in." But how is a whole train-load of passengers to be accommodated in comfort for sleeping? Our problem is soon solved by the appearance of our car conductor, who proceeds to effect a transformation of our coach.

We are travelling in what is known as a "standard sleeper." One by one the seats are pulled out to meet in the middle, and so to make a series of beds; then the under part of the roof of the car, on each side of the "clerestory," is lowered to form a second series of beds, above the first. There are now therefore two rows of beds down each side of the central aisle of the car, one row above the other, all properly made up with inviting white bed-clothes; and the last stage of the transformation is the drawing of long curtains down both sides of the aisle, for privacy. Thus every traveller on the train has his or her own bed. The only disadvantage is that we have to undress practically in our berths—an acrobatic performance that takes some getting used to—although the payment of an extra fare would secure places for us in a compartment sleeping car, more like the type in general use in our own country. But the American type of "sleeper" is so characteristic of the country that we feel that we really must go through the experience.

During the night we are forging westward through Southern Ontario, skirting the north side of the game reserve known as Algonquin Park, and reaching the important railway centre of Sudbury, 439 miles from Montreal, at 7 o'clock on Tuesday morning. Here our train is made up to its full weight by the addition of the portion that left Toronto at 11 o'clock on Monday evening. This complete formation consists of, first of all, the dining car, baggage car, compartment sleeping car or cars, as many standard sleeping cars as the traffic warrants and, on the rear, a compartment observation car, all from Montreal through to Vancouver; several standard sleepers from Toronto to Vancouver; and a compartment sleeping car from Toronto to Winnipeg only. Other coaches are attached and detached at intervals, such as a couple of "parlour cars" from Montreal to Ottawa, and a standard sleeper from Fort William to Winnipeg. All the passenger accommodation consists of Pullman cars, so that it is impossible to board the train without paying the Pullman supplementary charge, over and above the ordinary or "coaches" fare.

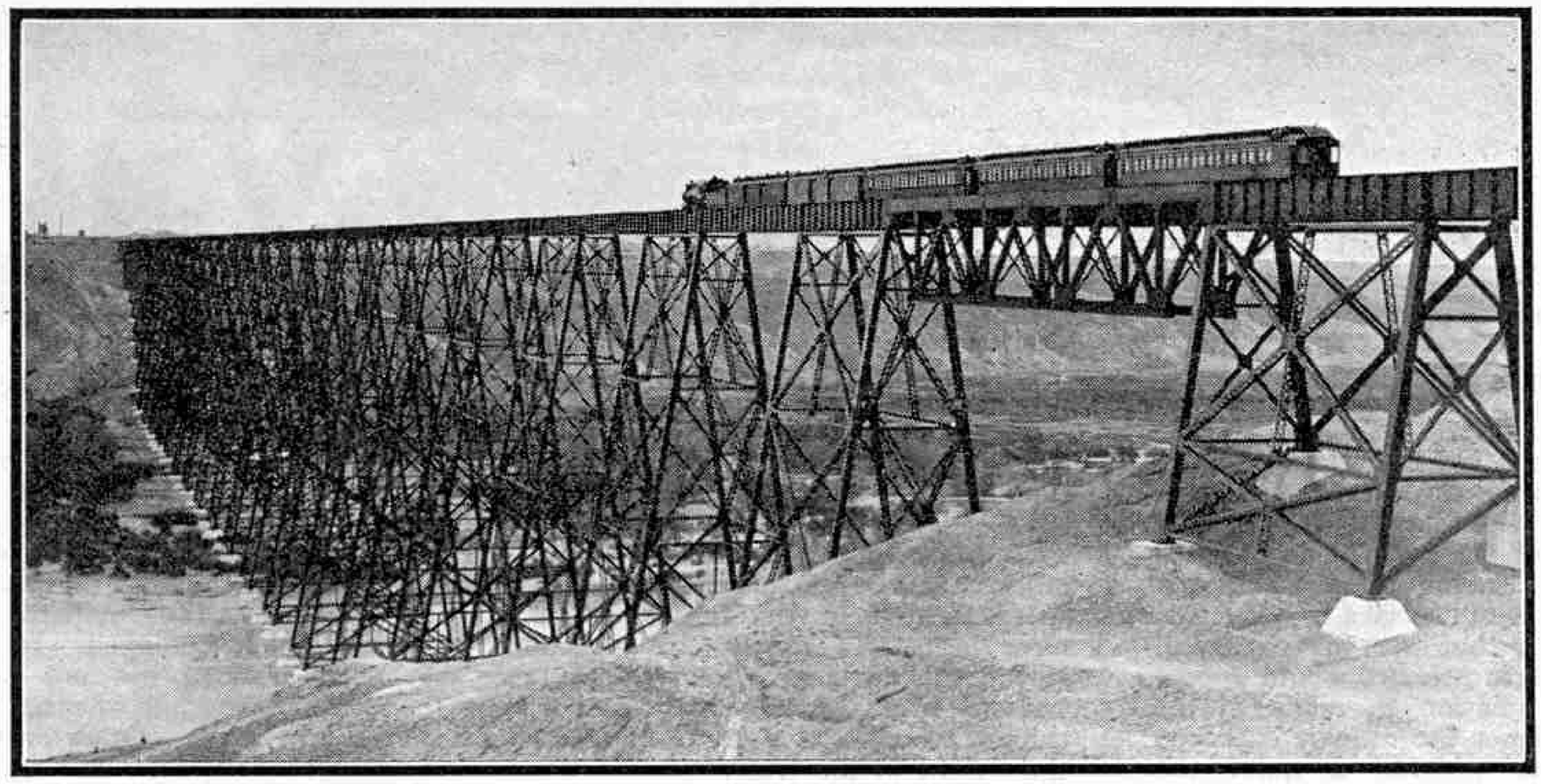
From Sudbury until we strike the north side of the vast inland sea known as Lake Superior—biggest of all the "Great Lakes" that separate Canada from the United States—we pass through some of the wildest country in Canada. It is a jumble of ragged rocks, rambling muskeg or swamp—which gave endless trouble to the original engineers of the line in finding a firm path for their track—small lakes and dense tangled forest. During this stretch we go over a maximum altitude of 950 ft., but the steepest gradient has been kept down to 1 in 100. Then at Heron Bay, half-way between Schreiber and Fort William, we emerge on to Lake Superior, along the shore of which a foothold has been obtained for the railway by blasting a gallery out of granite, mica, schist and trap. Parts of this 66-mile section along the lake cost £140,000 per mile, and on 200 miles of track through Southern Ontario 2½ millions sterling were spent. Midnight has just passed when, in the earliest hour of Wednesday morning, we roll into Port Arthur, and then immediately afterward into Fort William. If it were not dark we should see here the huge grain elevators in which the grain, fresh from the great prairies of the West, is stored and subsequently loaded into sea-going steamers, which pass across Lake Superior and through the chain of the Great Lakes and the Welland Canal to reach the River St. Lawrence and thence the wide Atlantic.

Before we go to sleep on Tuesday night we must put our watches back an hour, as we are passing from Eastern to Central American time. So, although we reach Fort William at 12.25 a.m., we start again at 11.40 p.m. having apparently made three-quarters-of-an-hour out of nothing in the course of our 15-minute halt! At Fort William we are only seven miles short of the first "1,000" out of Montreal.

Through the night we run over the busiest stretch of the Canadian Pacific main line in Central Canada, over which passes all the produce of the prairies. The line is now almost entirely double-tracked for the next thousand miles, and is fairly level as well. It is soon after breakfast that the outskirts of the great Middle-West

city of Winnipeg come into sight, and by 10.45 a.m. we have stopped at the main station, 1,412 miles from Montreal. Winnipeg is noted for the vast marshalling yards in which the trains of grain from Manitoba and the more westerly states of Saskatchewan and Alberta are assembled and marshalled. Through miles of these sidings we run; in fact, they include in all 120 miles of trackage, and are believed to be the largest group of railway sidings in the world.

After half-an-hour at Winnipeg, at 11.15 a.m. we head west again over the rolling prairies of Manitoba. This is a fairly thickly populated province and has railways radiating in many directions. There are many reminders in the ensuing hours of the Red Indian days of long ago, in the names of what are now such prosperous towns as *"Moose Jaw," "Swift Current"* and *"Medicine Hat."* By the evening of Wednesday, too, our train is beginning to mount, imperceptibly at first, but none the less surely, toward the crest of the Rocky Mountains far ahead. At Winnipeg we were 772 ft. above the sea; between Broadview and Regina we ascend to 2,132 ft., and then drop to 1,778 ft. at Moose Jaw, 1,810 miles from Montreal, which we reach at 8.50 p.m., and remain at for 20 minutes. Swift Current, 2,132 ft. above the sea, we clear just after Wednesday midnight, and in the next hundred miles we pass from Saskatchewan into Alberta. All this time, by the way, we are running parallel to the United States frontier and not much more than 60 miles north of it, as the C.P.R. is, for most of its length, in the extreme south of the Dominion of Canada.



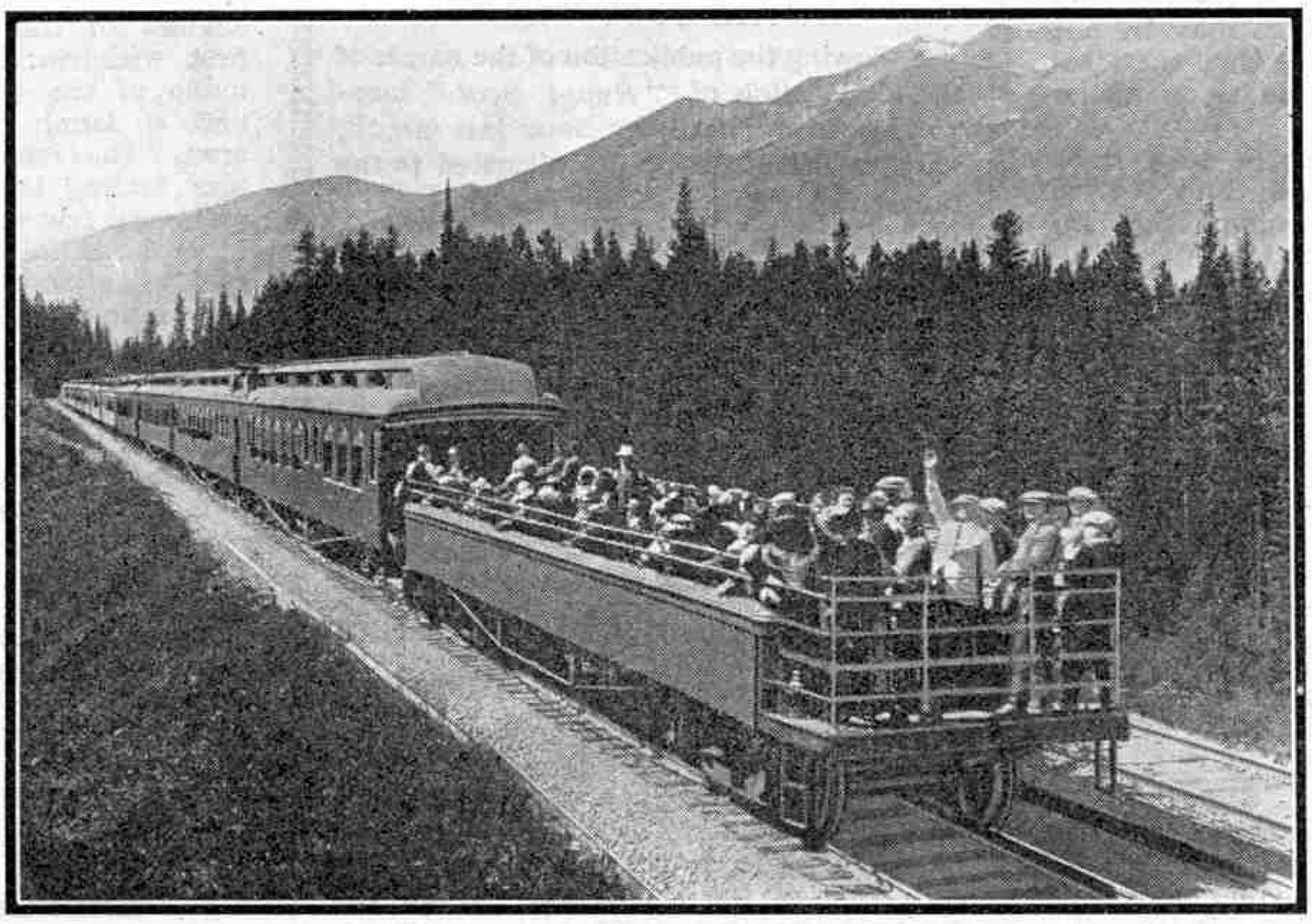
Lethbridge Viaduct, Alberta

As we pass into Alberta we find grazing for the most part taking the place of wheat-farming; it is in this province that the Prince of Wales has his ranch. Just after our Thursday breakfast we make Calgary, the capital of Alberta, having now travelled 2,244 miles from Montreal, and ascended to a height of 3,415 ft. above the sea. Still we have to climb on toward the summit of the Rockies, now immediately ahead of us. This is the most interesting stage of the whole journey, from the engineering standpoint. To assist us in the climbing we shall probably have the services of a big 2–8–2 " pilot " and, for our enjoyment of the mountain scenery, a large open observation car—like a big bogie wagon fitted with garden seats—is attached to the rear of the train.

To the summit point at Stephen, where the line is 1,901 ft. above Calgary and no less than 5,329 ft. above the sea, the original engineers of the line managed to preserve their even ascent of 1 in 100. But, once the " Great Divide " had been crossed, in order to escape extensive tunnelling down the wild gorge of the Kicking Horse River an " emergency " line was laid from Hector down to Field, dropping no less than 1,143 ft. of which 953 ft. was in just over four miles. This entailed a gradient as steep as 1 in 23 for the bulk of this distance.

What an obstacle this " Big Hill " opposed to economical working may be understood when I say that the working of 750 tons of freight against the grade required the services of four " Consolidation " (2–8–0) locomotives, each of 154 tons' weight. Spring safety switches had to be provided at various points, too, normally set in such a manner as to divert descending trains into catch sidings, unless the engine-driver signalled to the switchman that his train was properly in control.

The so-called " temporary " route remained in use for nearly 30 years, but at last the question of easing the gradient had to be faced seriously. It was done by the laying of an entirely new route, similar in character to the double loop of the St. Gotthard Railway of Switzerland, over which we travelled a couple of months ago. The railway descends one side of the valley much more gradually than before, and is then carried into a spiral tunnel under Cathedral Mountain. Emerging in the opposite direction, at a level lower by 50 ft. it is passed backward up and across the valley, though still descending, into another spiral tunnel under Mount Ogden, on the opposite side of the valley. From this it comes out in its original direction and proceeds down this side of the valley to Field.

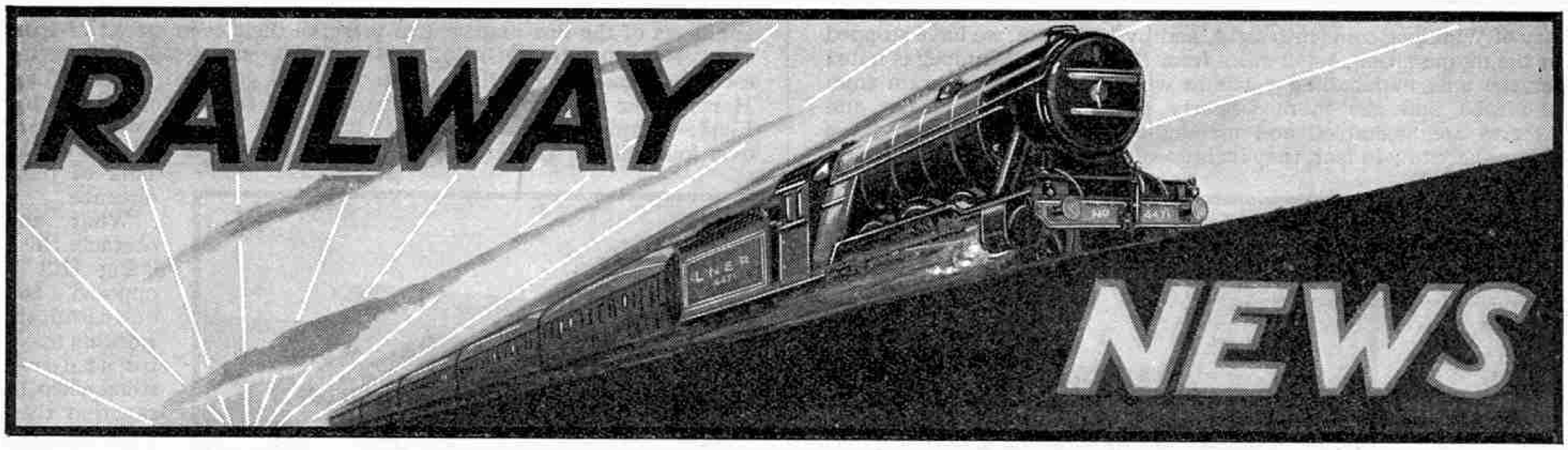


***" Trans-Canada Limited "* in the Rocky Mountains, with open observation car on rear**

By the new alignment, although the distance covered has been increased by four miles, yet the maximum gradient has been reduced to 1 in 45. Two of the freight engines previously mentioned can now work 980 tons of freight up from Field to Hector without further assistance, or 230 tons more than was handled by four of these engines previously. As we descend the Kicking Horse Valley by the new route—overlooking the old, which has now been turned into a driving road—we shall realise that the million dollars expended on this re-alignment was a profitable investment.

Field is reached at 2.30 p.m. on Thursday, and for the second time our watches must be put back an hour, now from Central to Pacific time; thus it is that we leave

(Continued on page 407)



Rail Coaches

The L.N.E.R. have decided to extend the use of rail coaches to certain portions of their system in the Derbyshire area. It may be assumed that this is a further attempt to meet the competition of the road omnibus by the provision of a cheaper and more frequent service within the country districts that are to be served.

The rail coach in practice would appear to supply the solution to many of the problems that beset the railway company endeavouring to provide a quiet but growing countryside with a frequent service compatible with reasonable operating costs. It is usually estimated that the operation of an ordinary type passenger train weighing 150 tons and providing accommodation for 240 passengers, over a local branch line say 10 miles in length, is 3/6 per mile, assuming that a two-hour service is given. Obviously a considerable amount of time is wasted at the terminal and junction. This wastage may be put at 65 per cent., and all the time the locomotive continues to consume big quantities of coal!

Contrast this experience with that provided by the rail-coach train. With two coaches giving accommodation for 120 passengers, its capital cost is considerably less than that of the train just mentioned, and its running costs have officially been stated at approximately 6d. per mile. Thus it will be seen that a rail-coach can be run more frequently at a mere fraction of the cost of steam train operation. The driving facilities are at one end only and no time is lost in running the locomotive round to the front of the train at each end of its journey. When the traffic demands are not heavy the second coach can be detached entirely, and if necessary goods traffic can be handled at the same time.

* * * *

The G.W.R. Crest

Following the recent change in the style of the exterior decoration of passenger coaches on the G.W.R., a further innovation has been made. In this case it is in the heraldic design only. Hitherto the crests of the cities of Bristol and London have been displayed in transfer one on each side of the G.W.R. coat-of-arms, and encircled by a garter bearing the words "Great Western Railway." The latter and the background "mantle" are no longer used and the crests of London and Bristol are transferred to the coat-of-arms, as in the form used on the Company's stationery and official publications. This revised crest is being used also on the tenders of all express passenger locomotives now going through the shops.

The World's Record Non-Stop Run

What was certainly the longest non-stop run up to that time, and possibly is still the longest, was performed in 1876 by an old 4-4-0 engine that hauled a theatrical train from Jersey City to Pittsburg, 438 miles, in 10 hours 5 minutes. The average speed throughout the run is claimed to have been 43.5 m.p.h. In any circumstances this was a remarkable performance, but its true value for record purposes cannot be assessed without knowledge of the weight of the train.

The "*Railway Magazine*," in commenting on this performance, points out that it was conducted purely as an advertising "stunt" for a theatrical company. Special provision for coal and water supplies, beyond those carried in the engine and tender, had to be made.

"*ROYAL SCOT*" NAMES

Following the publication of the names of the first batch of "*Royal Scot*" locomotives in our Railway News last month, we give below the names allocated to the remaining engines of the class.

6125	Lancashire Witch	6137	Vesta
6126	Sanspareil	6138	Fury
6127	Novelty	6139	Ajax
6128	Meteor	6140	Hector
6129	Comet	6141	Caledonian
6130	Liverpool	6142	Lion
6131	Planet	6143	Mail
6132	Phoenix	6144	Ostrich
6133	Vulcan	6145	Condor
6134	Atlas	6146	Jenny Lind
6135	Samson	6147	Courier
6136	Goliath	6148	Velocipede

6149 Lady of the Lake

Smoke Screens on "King Arthurs"

Several of the deservedly-famous S.R. "King Arthur" class engines have been fitted with a new type of smoke screen that takes the form of a steel plate fixed to the outside frame of the engine on each side of the smokebox. When the engine is running, these plates induce a current of air that carries the smoke and exhaust steam from the funnel well clear of the cab windows, and also promotes the draught essential to good steaming. In recent years many engines in Germany have been fitted with a somewhat similar contrivance, but its application in this country is an innovation. The powerful "King Arthurs," when working under easy steam on moderate duties, have such a soft "beat" of the exhaust that trouble has been caused by the smoke failing to rise clear and thus obstructing the view of the driver. R.S.M.

Scrapping Engines

In three of the four great Railway Groups, various classes of comparatively modern engines are either scrapped or marked down for destruction.

The Great Western 4-4-0's of the "Flower" class, although much more recent than the "Atbaras" and "Cities," are being scrapped. It is stated that their framing has not been so sturdily designed as that of other express engines on this line. Other withdrawals from service include the first of the "De Glehn" 4-4-2 compounds imported from France some 25 years ago.

On the L.M.S. certain of the original six-coupled "Experiment" class have already gone to their long rest, and now they are being followed by one or two of the famous "Precursors" that have apparently been considered too worn out for fitting with superheater equipment, as has been done in the case of many engines of this class. In addition, the first withdrawal from service has been made of the 4-4-2 "Precursor" tanks, once so familiar in the London suburban area. The remaining "Precedents" are also finding their way to Crewe works, and very few remain in service. On the other hand, old mixed traffic 0-6-0's of the "Cauliflower" or 18-inch type have been refitted with Belpaire boilers and Pop safety valves and still do much hard work. Of the DX goods class, which were old at the end of last century even, quite a number remain at work, a remark which applies to the small-wheeled coal tender and tank classes.

On the L.N.E.R., the earliest 0-8-0 class of mineral engines built by the late Great Northern Railway under Mr. Ivatt, have been scrapped. Several were fitted with superheaters, and the class worked chiefly in and about the brickyards and goods sidings at Peterborough. The last of the old Great Northern 2-4-0 passenger engines has also been broken up.

R.S.M.

* * * *

Accelerated Freight Services

Considerable acceleration of G.W.R. trunk line services to the West of England, South Wales, Midlands and the North has recently been effected, and Cornish traffic is now delivered the next day after despatch from London. The wagons are thus available for reloading the same night.

A new express freight train leaving Paddington Goods Station at 9.10 p.m. for Birkenhead makes what is claimed to be the longest non-stop freight-train journey in the British Isles. This is from Greenford (Middlesex) to Shrewsbury—a distance of 145½ miles.

"River" Tank Engines

Subsequent to our report that the "River" tank engines were being reinstated on the Southern Railway, we learn that these engines have been withdrawn and are now being fitted with tenders.

This decision of the Southern Railway doubtless is made to allay any public fears connected with the operation of the "River" tanks. Colonel Sir John Pringle's report on the Sevenoaks accident clearly stated that the engines were not responsible and that the accident was due to a fault in the permanent way. It was commented at the same time that the engines had a slight tendency to roll when travelling round curves at high speed, but in this connection it is interesting to study the report of the trials of Nos. 803 and 890 of the "River" class on L.N.E.R. tracks in October last.

A series of a dozen tests were carried out, the engines being set to run forward and backward in up and down directions on a certain stretch of line, with the tanks and bunkers nearly empty, full, and nearly full. Speeds ranging from 56¾ to 83¼ m.p.h. were attained and the observations made during the trials show that generally both engines ran without roll or lateral motion on the straight and on curves, except for an occasional slight roll. No. 890, with which 83¼ m.p.h. was attained, was running bunker first at the time and there was neither rolling nor lurching when at its maximum speed.

In a subsequent trial on the Southern Railway itself the engines are reported to have rolled slightly at several points and to have been slightly less steady than on the L.N.E.R. tracks, so that it appears that the fault does not lie with the design of the engine, but with the track.

* * * *

Third-Class Sleepers

As an experiment during the coming summer season the L.M.S. and L.N.E. railways are to introduce third-class sleeping accommodation on their principal night trains. Several third-class corridor coaches are now being converted for the purpose. The berths each will contain two bunks, mounted one above the other on one side of the compartment, while on the other side there will be all the essential toilet equipment and space in which the passengers can undress and dress in perfect comfort.

* * * *

"Royal Scots" Re-Shedded

Recently there has been a revision of the shedding arrangements for the "Royal Scot" class locomotives. Nos. 6100–9 are now at Camden; Nos. 6110–3 at Rugby; Nos. 6114–26 and 6133–4 at Crewe; Nos. 6135–9 at Carlisle; Nos. 6140–9 at Edge Hill, and 6127–32 at Polmadie (Glasgow).

London-Edinburgh Non-Stop

The London and North Eastern Railway Company announce that commencing 1st May the "*Flying Scotsman*" will perform its journey between London and Edinburgh—392 miles—without stopping in either direction.

The world-famous "*Flying Scotsman*" has left King's Cross, platform 10, every week-day for Edinburgh (Waverley) during the last 66 years. Last year it covered the distance to Newcastle—268 miles—without a stop on four days per week—which was at that time a longer booked non-stop run than any other in the world. This year it has been found possible to bridge the whole 392 miles to Edinburgh without intermediate halt of any kind. The new non-stop run thus achieved will be the longest in the world.

The popularity of the non-stop run to Newcastle last year made it clear that there was a great public demand for improvements of this kind, and the L.N.E.R. have for some time been exploring the possibility of extending the distance to be covered. At one time it was felt that the limit of the powers of a single engine crew had been reached and on grounds of safety that it was undesirable to carry two crews on one engine. A solution to the problem is supplied by the provision of a corridor on the tender, connecting with the leading coach. After running for 200 miles the driver and fireman will be able to hand over their duties to a fresh crew and leave the footplate.

The engines employed are the famous "Pacifics" and each has been fitted with a new type tender, having the same capacity as the earlier "Pacific" tenders, 5,000 gallons of water and 9 tons of coal, and varying only in the provision of the corridor connection. The corridor extends down one side of the tender and is 1 ft. 6 in. in width and 5 ft. in height. The rear of the tender is provided with an automatic coupling and Pullman vestibule exactly similar to those used in the corridor carriages. The "*Flying Scotsman's*" schedule will not be speeded up for the new run but passengers for Edinburgh and beyond will have the comfort of an uninterrupted journey.

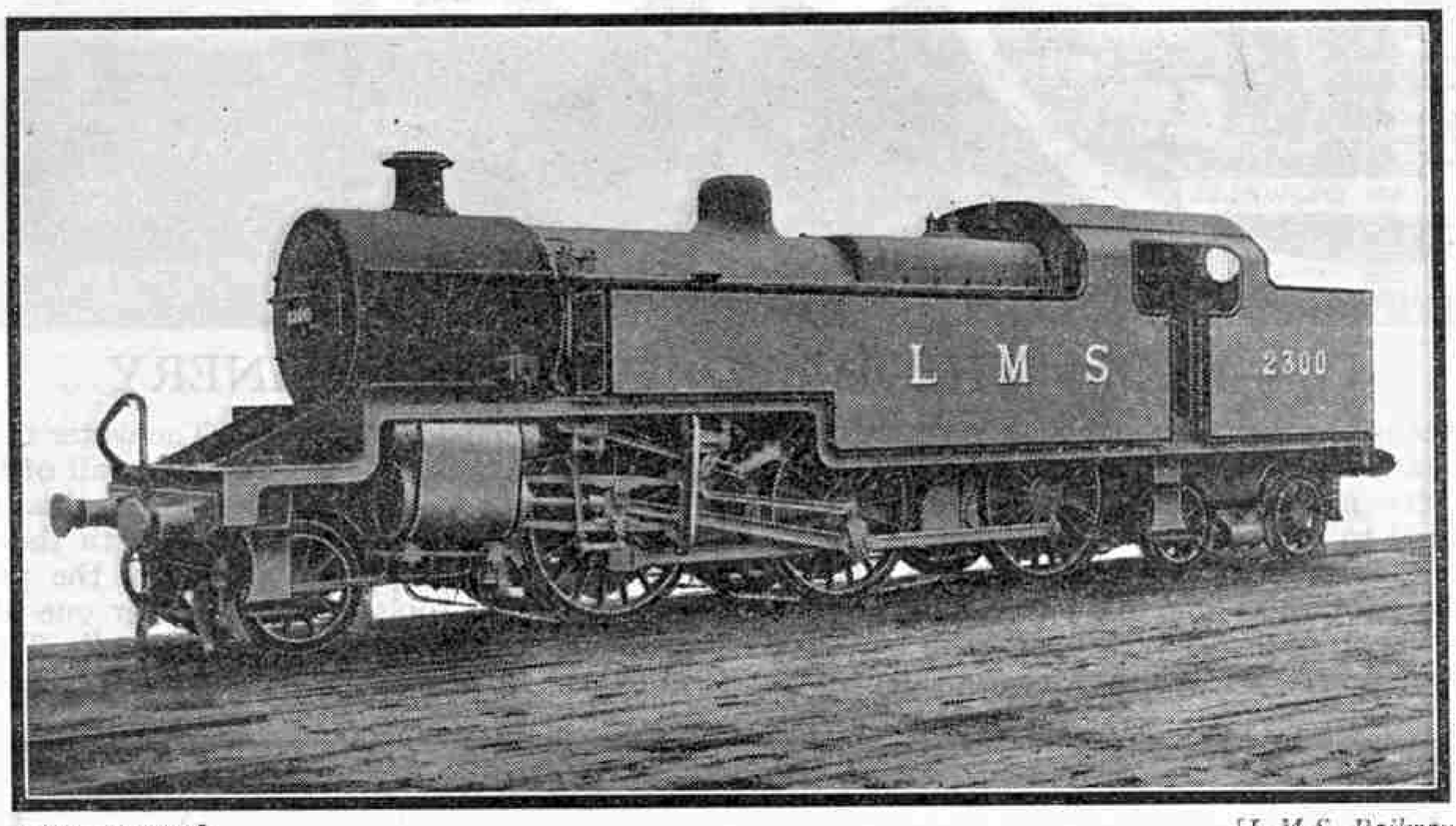


Photo courtesy] [*L.M.S. Railway*

Our photograph shows one of the new London, Midland and Scottish Railway 2-6-4 tank locomotives now being built at Derby, the numbers of which run from 2300 to 2324.

The cylinders of these locomotives are 19 in. × 26 in., the diameter of the coupled wheels 5 ft. 9 in., total heating surface 1,220.25 sq. ft., and superheater heating surface 266.25 sq. ft. Grate area 25 sq. ft. Boiler pressure 200 lbs. per square inch. Weight in working order 86½ tons. Tractive effort 85%. B.P. 23,125 lbs. Water capacity 2,000 galls., and coal capacity 3½ tons.

Southern Railway Electrifications

The Southern Railway suburban electrification scheme advances a further stage toward completion with the opening up of the line from London Bridge to Purley, including the Caterham and Tattenham Corner branches, and the London Bridge-Crystal Palace section, via Forest Hill. This is a further 86 miles of track, all of which is operated on the third rail system. A further section, covering the South London line between London Bridge and Victoria and the section between London Bridge and Epsom Downs, will be opened in June. This consists of 79 miles of track, of which one-half will be converted from overhead transmission to the third rail system of operation. The final stage of the Central Section scheme will be completed early next year, when the Victoria-Epsom, London Bridge and Dorking North, and the City and Wimbledon sections will be brought in.

With the completion of these three stages of the big Central Section scheme, the Southern Railway will have spent 11½ million pounds on electrifying 875 miles of track, including 125 miles converted from overhead to third rail operation. It is by far the biggest conversion scheme that has ever been attempted.

The rolling stock that will work the new services will be made up of 42 three-coach motor units, each providing seating accommodation for 56 first-class and 180 third-class passengers. There will also be five two-coach trailer units, each with seating accommodation for 190 third-class passengers.

* * * *

A Road-Rail Truck

With a view to speeding up the transport of freight in this country the L.M.S. Railway have introduced a "container" wagon that is adaptable for conveyance both on railway wagons and motor lorries. This new service is really an extension of a system that has been in use for several years by furniture removers and certain big manufacturers who employ their own containers. The idea is to provide a means of transport by which goods can be conveyed direct from consigner to consignee without the handling that hitherto has been unavoidable in transshipping goods from railway trucks to lorries for delivery.

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L.M.S. Locomotive Livery

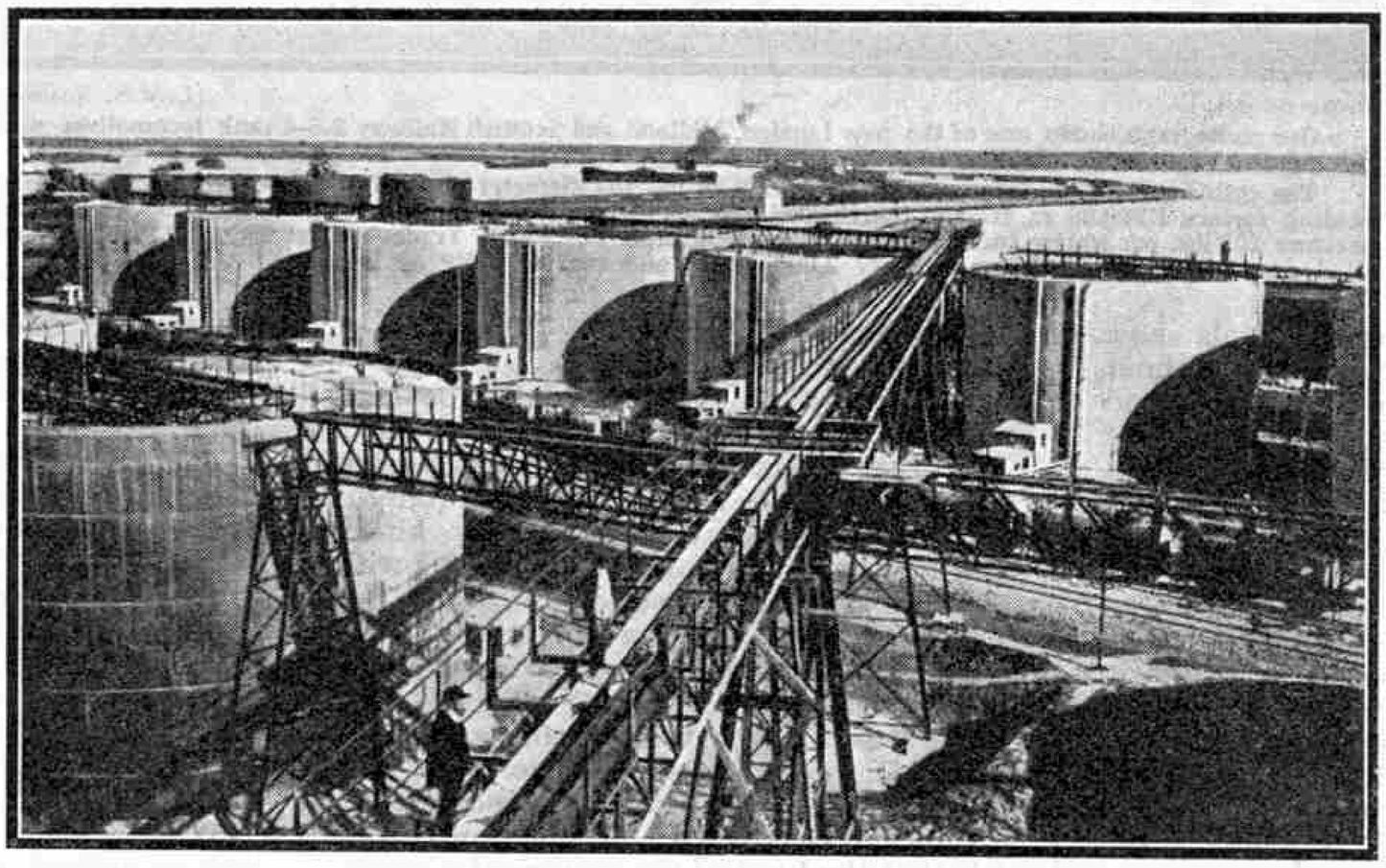
Under a scheme recently adopted by the L.M.S. all engines are to be painted black in future, with L.M.S. on the tender and the number on the cab side in yellow, and the name, if any, in yellow on the splashers. The "Royal Scot" engines and the Midland Compounds are to remain red but one or two exceptions to this may be found later.



IV.—FROM THE WELL TO THE REFINERY

THE task of the pioneer oil prospector is often a very arduous one, for he may have to commence operations in a country or locality where every mile of road has to be made before any of the materials required to establish an oil-well can be transported to the selected site. Sometimes the natives of the district resent the intrusion of the prospector and his small company of engineers, and until the peaceable nature of their operations becomes thoroughly established the seekers for oil may carry their lives in their hands.

The method employed in drilling a modern oil-well is practically the same as that inaugurated by Colonel Drake when he drove the first oil-well in Pennsylvania during 1859 as related in the February *"M.M."* The equipment used varies in almost every oilfield, however, and the type of drilling tools to be adopted for exploiting a new field is determined by the conditions revealed during the boring of the first well in the locality. Special attention is given to the drilling of this well and the greatest care is taken to ensure that a correct geological record of the successive strata penetrated by the drill is obtained. The amounts of gas and water encountered are also carefully noted and are taken into account in deciding upon the type of drill that is best suited for operations in that particular field.



Oil Storage Tanks at Constansa, a Rumanian port on the Black Sea

When the necessary tools and equipment have been conveyed to the site, operations are commenced. The first task is to erect the familiar tower or "derrick" that is to house the boring apparatus. In countries where the atmosphere is consistently dry the derricks of oil-wells are built of timber and last for many years, but where the climate is very moist they are constructed of steel lattice girders to ensure durability. Steel derricks are used also in tropical countries where timber structures suffer greatly from the ravages of the white ant. The oil-well derrick is generally about 100 ft. in height, and inside the tower is rigged up an arrangement of cables and pulleys for manipulating the boring tools.

There are various methods of boring wells but these are mainly variations of two principal methods, the hydraulic rotary system and the percussion system. The former has been adopted almost exclusively in the oilfields of Mexico, Louisiana and Texas, where the strata contain a preponderance of sand and light clay. The cutting "bit" is attached to the lower end of a long column of "drill pipe" which is then lowered down the borehole. As the pipe rotates the tool cuts away earth. The debris is washed up out of the borehole by a constant stream of water that is pumped down the interior of the drill pipe and emerging at the bottom is forced up outside the pipe. The water that thus passes up between the exterior of the pipe and the wall of the borehole also aids the cutting tool to maintain a true vertical course by preventing the pipe from coming into contact with the earthen wall of the well.

The drilling apparatus used in the percussion system includes a number of tools linked together one above the other and comprising what is called a "string." The lowest of the tools is the bit. This may be a hollow instrument of from 4 ft. 6 in. to 6 ft. in length and 2 ft. or more in diameter, according to the width of the borehole required, or it may be one of a variety of other patterns. A circular bit sometimes weighs nearly two tons. The bottom of this type of drill diminishes to a fine cutting edge, while the top tapers after the manner of a bottle and the narrow head is screwed into the base of an auger-stem, a section of the string that may be as much as 40 ft. to 50 ft. in length. The top of the auger-stem is attached to the "sinker" and "rope-socket," of which there are many different types.

The wire rope to which the string of tools is attached extends upward to one of several pulleys in the peak of the derrick and passes over this and down to a reel or winding drum at the base of the tower. A pulley at one end of the drum carries an endless belt that passes around a similar wheel mounted on a shaft at the opposite side of the derrick. This shaft is rotated from a steam engine situated a considerable distance from the well, and also carries a huge pulley that imparts a see-saw motion to an elevated horizontal beam, about 26 ft. in length and similar to the beam of a Newcomen steam engine. A mechanism known as a "temper screw" is attached to the end of the beam that is inside the derrick.

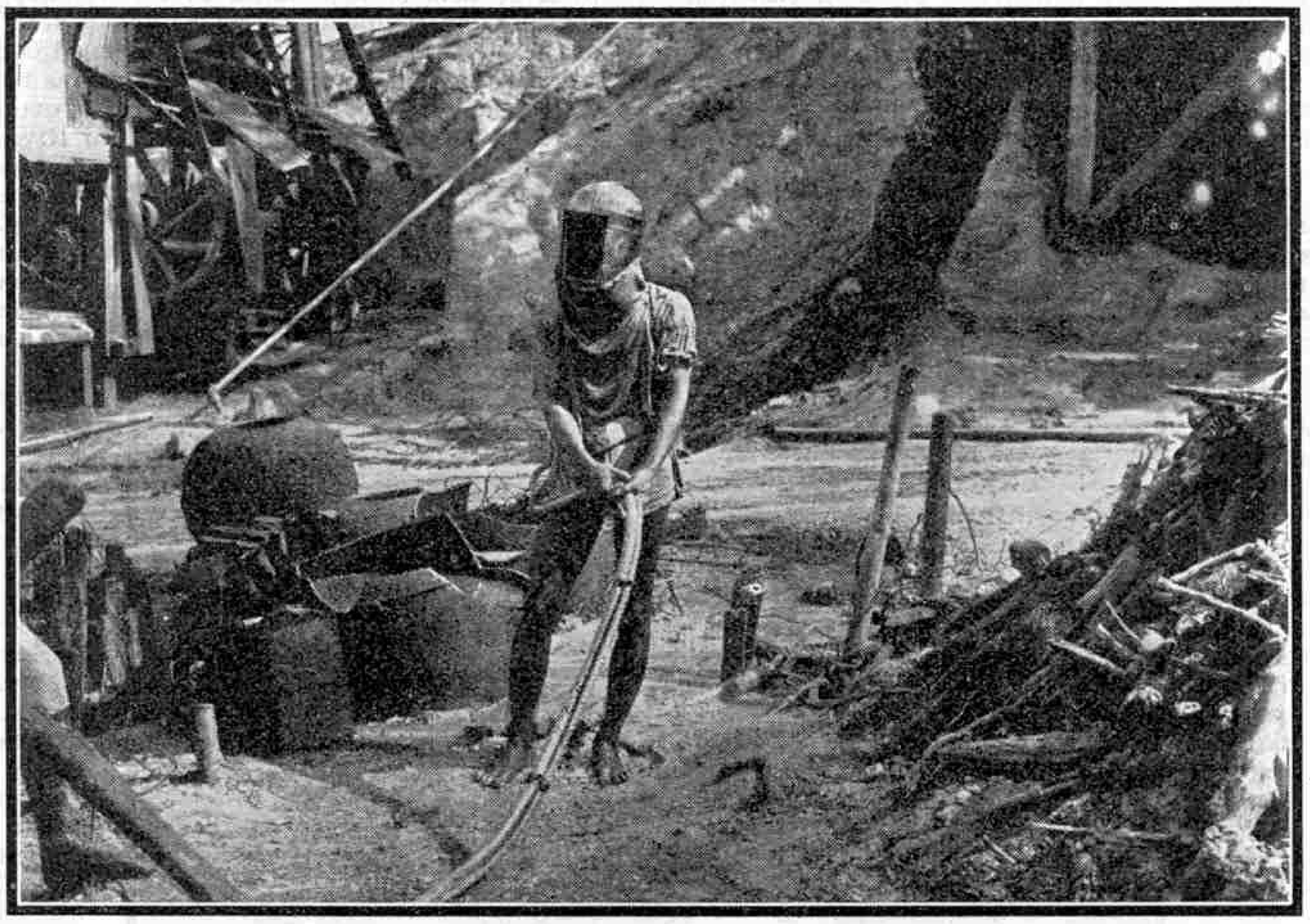
The cable suspending the string of tools passes through the temper screw, which grips the rope tight. As the derrick end of the beam cants upward it pulls up the lower portion of the cable and so raises the string of tools. Then when the upraised end of the beam cants downward the consequent sudden slack upon the cable allows the string to descend under its own weight and the cutting tool strikes the bottom of the borehole with great force, rebounding before the next movement of the beam again sharply pulls up the cable and lifts the tool for the next blow.

The bit is made of special steel designed to retain a fine cutting edge as long as possible. This edge eventually becomes dull, however, and boring is then stopped, the temper screw is relaxed and the string of tools drawn up out of the well in order that the

bit may be replaced by a new or a re-sharpened one. The re-sharpening of the cutting tools is carried out in an adjacent blacksmith's shop.

The rock or other material hacked away by the terrific blows of the bit is brought up out of the borehole either by means of water and a "baler" or sand pump, or by the continuous pumping of water down the well, in which case the debris is washed up to the surface.

Oil-wells are lined with iron or steel casing to prevent them from falling in and to ensure a clear course for the upward flowing oil stream. When the borehole has reached a depth sufficient to allow the first length of well casing to be inserted, this is carefully lowered by means of a cable that is controlled from the winding drum at the base of the derrick and passes over one of the pulleys at the top of the tower. The cable also serves to ensure that the pipe is inserted into the well in an absolutely vertical position. When the borehole becomes deep enough for another length of casing to be inserted, the new length of pipe is lowered into position by cable and gripped firmly by a huge pair of chain tongs while it is being securely joined to the section of casing already in the well. Drilling is then resumed, and as the borehole steadily deepens the extended casing sinks lower and lower. New lengths of pipe are added as they become necessary, until the borehole enters the oil-sands and drilling is stopped.



A Diver about to descend a hand-worked oil-well at Yenangyoung

The requisite drilling plant and casing may cost any sum from £500 upwards. The pipes for lining the well are expensive items and soon add considerably to the cost of operations when boring is carried to a greater depth than was intended originally.

The natural tendency of the cutting tool is to adopt the path of least resistance, but it is of vital importance that the borehole of an oil-well should be absolutely plumb. Immediately the drill is found to be deviating from its true course boring operations are stopped, the string of tools is raised and re-drilling is carried out.

It sometimes happens that the string of tools becomes detached from the cable and, collapsing, completely blocks up the narrow borehole. The blockage is relieved by attaching to the cable a special drilling tool that widens out the borehole at the congested spot and thus loosens the jammed implements which are then secured and hoisted up to the surface. When only a portion of the string of tools become detached they generally fall to the bottom of the borehole and are recovered by means of "fishing" tools, of which there are numerous patterns for coping with all kinds of mishaps in the well. So comprehensive is the range of these implements that it is an extremely rare occurrence for a borehole to have to be abandoned on account of failure to recover from it broken or loose tools.

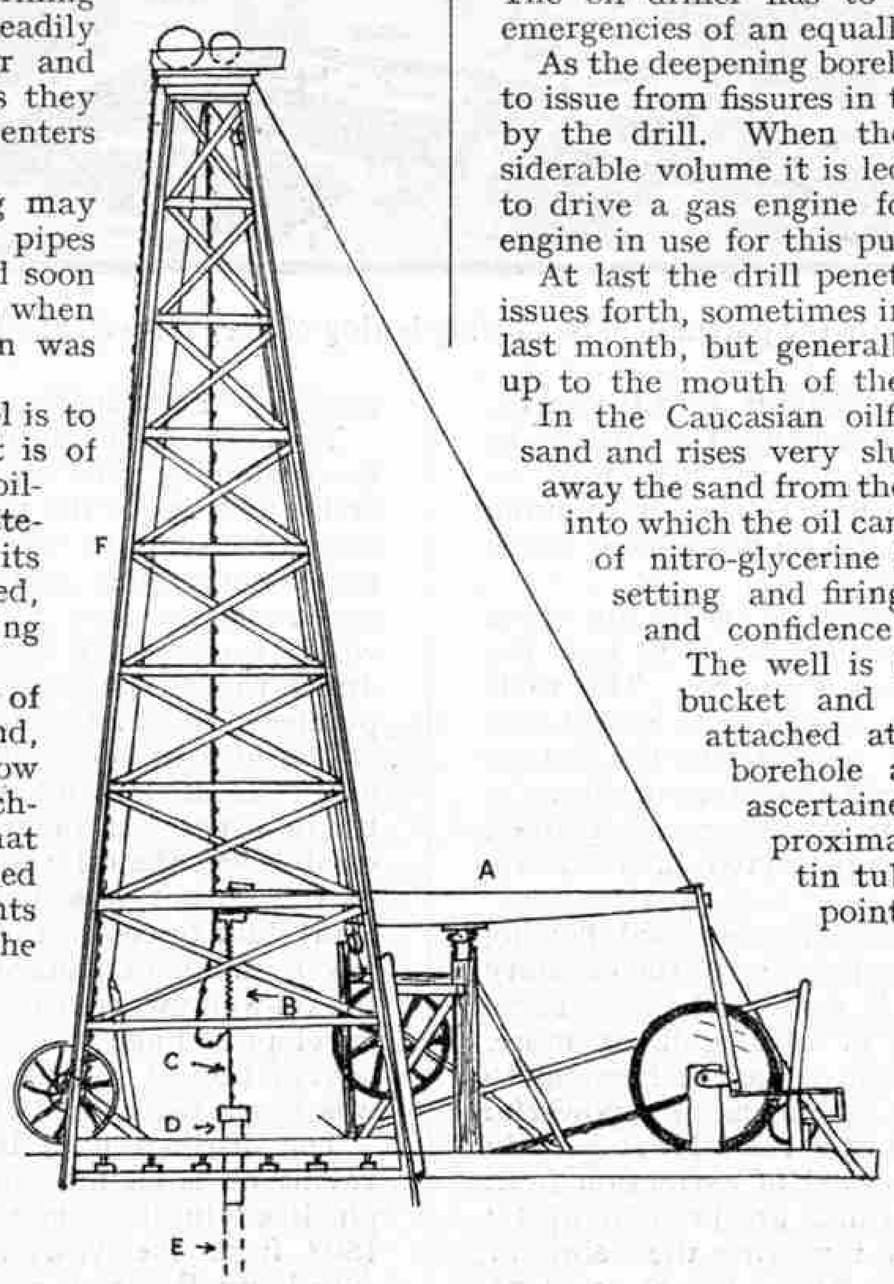


Diagram showing the main features of a typical oil derrick.
A—Beam B—Temper Screw C—Drilling Cable
D—Well-casing E—Borehole or Well F—Derrick

The task of clearing the narrow borehole of obstacles is a very slow one, however, and sometimes it is many weeks before the patient "fisher" succeeds in adapting his rescue implement so that it captures and brings up the broken or wayward tool. The problem may be aggravated further by the fishing tool itself breaking, or by sand rising up the well and covering the wrecked implements.

The worst enemy of the oil driller is water, and this is most formidable when encountered in a borehole that is being driven through clay and quicksand. When the driller finds that the water pumped down the borehole to wash up the debris is not returning to the surface, he knows that it is being absorbed by the sand. Water and clay, in a thick mixture, are then sent down the borehole to seal up the porous formation. The well casing is sunk past the faulty place as quickly as possible and the absorbent stratum thus completely shut off. Sometimes "pockets" or pools of imprisoned water are released by the penetrating drill, while it may happen that an intercepted subterranean spring that has been walled-off succeeds in bursting through the well casing and again invading the borehole. The oil driller has to be prepared for these and many other emergencies of an equally varied nature.

As the deepening borehole approaches the oil-bed, gas commences to issue from fissures in the well and pockets of oil are encountered by the drill. When the gas wells up into the borehole in considerable volume it is led off through special piping and is utilised to drive a gas engine for operating the drilling plant, the steam engine in use for this purpose being then laid off.

At last the drill penetrates the oil-sands and the precious fluid issues forth, sometimes in the form of a terrific gusher as described last month, but generally as a thick liquid that rises reluctantly up to the mouth of the borehole.

In the Caucasian oilfield the oil is heavily impregnated with sand and rises very sluggishly up the well. In order to clear away the sand from the base of the borehole and provide a cavity into which the oil can gravitate to facilitate pumping, a charge of nitro-glycerine is exploded at the foot of the well. The setting and firing of this powerful explosive calls for skill and confidence on the part of the "shooter."

The well is first cleaned out with the aid of a sand bucket and swab, and a steel tape with a plumb attached at the lower end is then lowered into the borehole and the exact depth of the excavation ascertained. A torpedo-shaped receptacle approximately 6 ft. in length, and having a small tin tube about 2 in. in length attached to the pointed end, is then lowered into the mouth of the well by means of a cord and pulley. The explosive is conveyed to the site in two-gallon tins and is poured into the suspended cylinder, which probably will accommodate 20 quarts of nitro-glycerine.

When the cylinder is fully loaded a metal lid having a cap made of fulminate of mercury is fitted and the cylinder is then gently lowered into the borehole. At the bottom of the well it becomes imbedded in an upright position in the heavy stratum of sand, and the cord is then unhooked by slacking and drawn

up to the surface. While these operations have been in progress, all fires in the neighbourhood have been drawn out. All naked lights are now extinguished and, with the exception of the shooter, the workmen hasten to put a good distance between themselves and the well.

The shooter now picks up a curious contrivance known as a "go-devil," consisting of a heavy cylindrical block of cast-iron equipped with small projecting blades or wings. When all his mates have retreated to a safe distance the shooter leans over the borehole and drops the go-devil down the well. It speeds downward into the darkness with increasing velocity, the wings causing it to rotate and maintain a true course. At last it strikes the mercury detonator on the cylinder lid with terrific force, and the explosion takes place. The expectant shooter hears with satisfaction the muffled roar below and notes the sudden vibration of the well casing. Thus assured that all has gone well, he sprints hastily after his fellow workmen.

The faint rumble in the depths of the borehole increases rapidly as the report of the explosion ascends and soon it is audible at a considerable distance from the well. Suddenly the full effects of the subterranean explosion become apparent to the watching workmen. With a terrific din, the ascending lumps of broken rock, clattering against the well casing, shoot high into the air amid a stream of sand, oil and gas. For a few moments the derrick is completely hidden from view by this dense fountain, but the outburst quickly subsides, and the shooter, returning to the well, sees only the oil rising leisurely but freely up the borehole. After being active for some time the well chokes up again and a double dose of explosive is then necessary to restore the outflow of oil.

During the early days of oil-well drilling it was customary to drive the borehole only a few hundred feet below the surface, but nowadays oil-wells are sunk from 5,000 to 10,000 ft. into the earth. At Olinda, near Los Angeles, U.S.A., a borehole has been driven to a depth of nearly two miles. The special 2 in. drill stem used on this occasion consisted of 95 sections each 85 ft. in length, making a total of 8,075 ft. All but 29 ft. of the drill stem had passed below ground level before the oil-bed was reached.

When an oil boom occurs in virgin territory, wells are often sunk by excited prospectors without any thought as to how the supply of oil is to be accommodated above ground. The wells come in one after the other and the lack of adequate receptacles for the oil results in the inflammable liquid saturating the district over a wide area. At an established oilfield this state of affairs is avoided, and while boring operations are in progress pipelines, reservoirs and storage tanks are being constructed in readiness for the oil when it arrives.

As soon as an oil-well comes into being, the upward flowing stream of crude oil is "capped" to restrict the flow to the capacity of pipelines that convey it to "sumps" near at hand. These sumps are small ponds with a capacity of 2,000 gall. or more. When the oil does not rise up the well with sufficient freedom to discharge itself effectually it is drawn up by means of a powerful pump. In the Rumanian and Russian oilfields the oil is so heavily impregnated with sand that even this method of extraction from the earth cannot be adopted and the oil-sands are brought up by means of balers similar to those used for removing the debris or sludge created during boring operations. These balers are long cylindrical receptacles each about 60 ft. in length and approximately 1 ft. in diameter. Their capacity varies from three to eight barrels. The baler is attached to a cable coiled around a winding drum inside the derrick and descends the well by gravity. On reaching the bottom the baler fills with oil-sands and when it is completely loaded the cable is wound in and the baler swiftly brought up to the surface and discharged.

From the sumps the oil passes through sluices, or gravitates, to large field storage tanks in the vicinity, leaving behind it a considerable sediment of sand. As a result of this "settling" of the fluid the sumps have to be cleaned out frequently. The oil storage tanks are large circular structures built up of steel plates, and some of them have a capacity of over 1,000,000 gall.

When the output of oil at the Kern River oilfield in California was defying all efforts to cope with it, the Standard Oil Company sought to accommodate the surplus outflow by excavating huge pits in the earth. These sunken reservoirs, averaged 450 ft. in diameter and 50 ft. in depth, and stout wooden posts inside each one supported a roof composed of boards 1 in. in thickness.

Another type of field storage tank was evolved by the Union Oil Company during the valiant efforts made to accommodate the excessive flow of oil from the wells of the San Joaquin oilfield at the time when this field came in. These tanks were built of ferro-concrete and were each 601 ft. in diameter, with a capacity of 1,000,000 barrels. The rim of each tank was consolidated by a reinforced concrete wall tapering from a thickness of 3 ft. at the base to 6 in. at the top of the bank. Some 80,000 cu. yds. of earth was excavated, and this material was used to build up an outer encircling wall some distance from the concrete one. Each tank was provided with a wooden roof, approximately 2,500,000 ft. of timber being used for this purpose. The work was carried out against time, and at the height of operations 600 men and 600 horses were employed at the site. The tanks and necessary pipelines cost about £100,000.



Connecting up the patent drill bit, during boring of deep oil-well at Olinda, U.S.A.

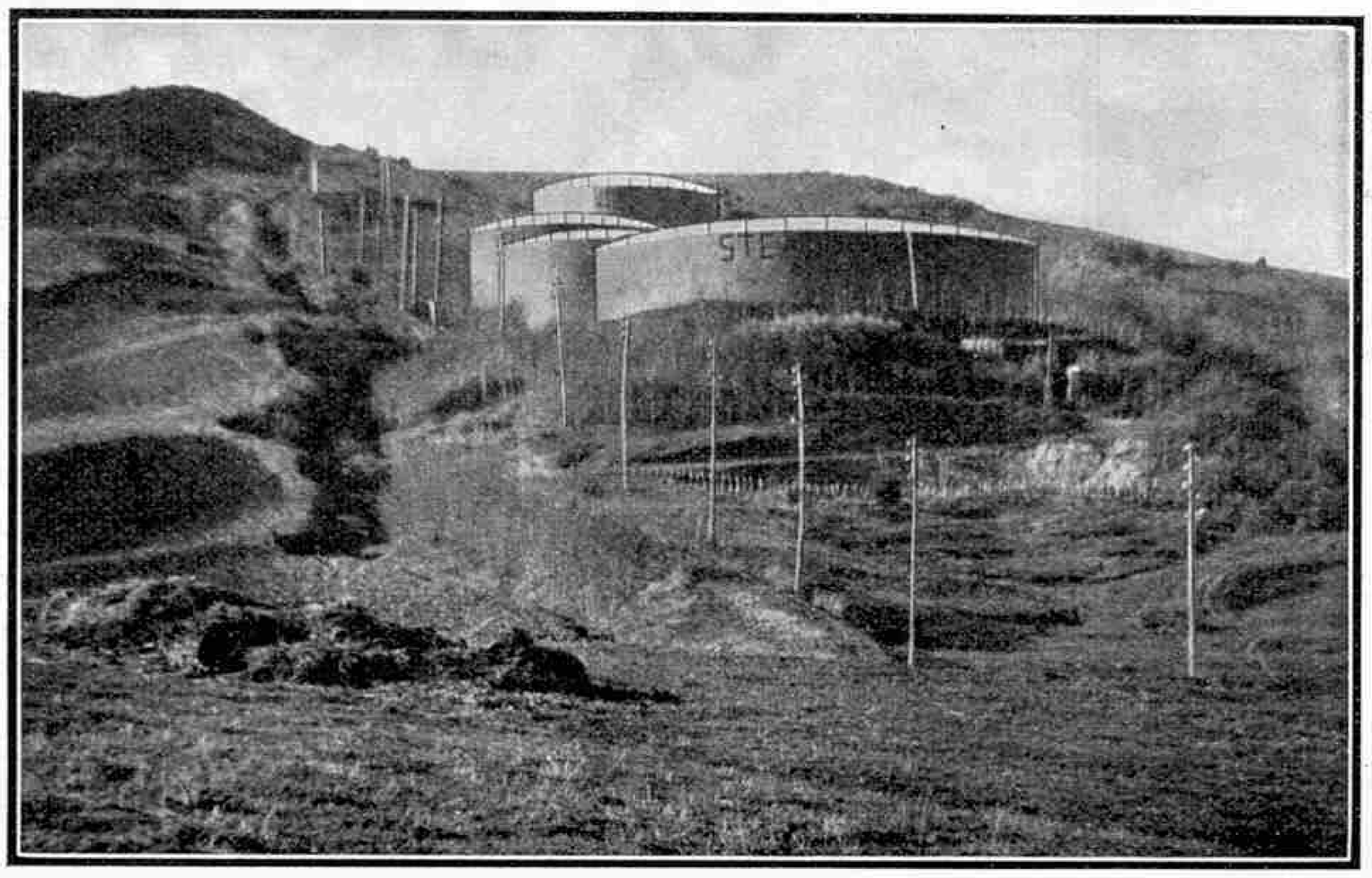
The crude oil is retained in the field storage tanks long enough for the remaining sand and water to separate from the oil and settle at the bottom of the tanks. During cold weather the oil becomes more dense and in order to hasten the settling it is passed through tanks containing an arrangement of steam pipes. From the field tanks the oil is pumped long distances through more pipelines, which transport it either to large storage tanks at a refinery or direct to a coastal "tank farm," from where it is subsequently pumped into oil tankers and shipped overseas.

The idea of conveying oil direct from the wells to distribution depots located many miles away originated in the early days of the industry. In Pennsylvania, U.S.A., where the first oilfield was established, the oil was loaded into barrels and the greater portion of the output was distributed by road. The teamsters charged exorbitant prices for this haulage, for they knew that, apart from the few roundabout waterways, there was no other means by which the oil-well owners could export their product. Later, as railways developed, huge conical shaped wooden vats were utilised to convey the oil in bulk from field storage to refinery, but this also was very costly, and eventually pipelines were instituted.

The distinction of being the first pipeline laid down for conveying oil is claimed by two early enterprises. One of these is a pipeline 2 in. in diameter and three miles in length that was laid in 1863 from the Warren Refinery to Warren's Landing, on the Alleghany River, U.S.A. The other line was five miles in length and was laid down by a man named Van Syckle from Miller's Farm to Pithole City during the period when the latter was an

important centre of the oil industry. It is said that Van Syckle got his idea from noticing how successfully water could be conveyed great distances by means of iron pipes. His proposition to construct a five-mile pipeline was ridiculed by the teamsters but he persevered and eventually the line was laid and proved quite successful. The teamsters regarded this experiment as a serious threat to their profiteering, and it was not long before the pipeline was torn up and the links of pipe either carted away or smashed.

The pipe had existed long enough to prove its practicability, however, and the construction of other similar projects was commenced. The teamsters repeatedly tried to bring operations to a standstill, one of their favourite methods being the intimidation of the workmen, sometimes at the point of the pistol. When these attempts failed the lines were fractured in isolated places where considerable time was bound to elapse before repairs could be made. In spite of this obstruction several pipelines were successfully established and by 1872 the employment of teamsters for oil transport had almost entirely ceased.



Petrol Reservoirs at the Petrol Works at Prededussport, Roumania

The majority of modern pipelines are 8 in. in diameter and comprise heavy, lap-welded, screw-jointed pipes capable of withstanding a pressure of 3,000 lb. per sq. in. Many of these pipelines extend for hundreds of miles, crossing valleys, mountains and plains en route from oilfields in mid-continent to refining stations near the coast. One of the longest pipelines of recent construction extends from an oilfield at Salt Creek, Wyoming, to Freeman, Montana, U.S.A., a distance of 720 miles. Pumping stations are provided at intervals along this line to relay the oil. At places where the oil projected through the pipelines is of a light, free nature, few pumping stations are required, and one is sometimes sufficient to pump the liquid several hundred miles. In the case of thick, heavy oils such as are obtained and piped in Mexico, however, pumping stations have to be provided every 10 or 15 miles.

The adoption of pipelines by America has been followed by other countries and there are several lines of great length in the oilfields of the East. One European line worthy of note is in the Caucasian oilfield, where crude oil enters a line in the Baku region and after a journey of 550 miles emerges at Batoum, a shipping port on the Black Sea. This pipeline was completed in 1905.

At the end of its long journey underground the crude oil is generally conducted to the vast storage tanks of a refinery, and the various processes to which it is subjected there will be described next month.

Fire is as much the enemy of the refiner as of the oil producer. When a storage tank becomes ignited, probably as the result of being struck by lightning, the fire is confined to the surface of the oil where contact with the air renders combustion possible. If there is an empty tank conveniently near into which the bulk of the oil can be transferred by pumping, the outbreak is not viewed with any particular alarm. When no such reserve tank is available, however, the contents of the burning tank have to be left to the mercy of the flames and the heat soon becomes so intense that the steel plates of the tank buckle and curl up. The blazing oil then gushes out through the fractures and soon the tank resembles a burning island amid a sea of flame. Desperate efforts are then made to prevent the rivers of blazing oil from reaching neighbouring tanks and buildings, and fire extinguishers and powerful steam jets are the most potent means of doing this. In this country oil tank fires are very rare, but in America the terrific thunderstorms that frequently occur take heavy toll of the oil storage farms, and it has been estimated that the combined loss from oil tank and gusher fires in the United States reaches 1,500,000 barrels every year, which represents a very serious financial loss. *(To be continued).*

Meccano Manuals in Chinese!

The Meccano Manuals of Instructions are published for no less than 20 different countries, and in each case they are printed in the particular language that is spoken in those countries. There are separate editions of the Manual for each of our Colonies, and for Argentine, Spain, France, Belgium, Luxemburg, Switzerland, Germany, Holland, Norway, Sweden, Denmark, Italy, Brazil, Portugal and China.

As may easily be imagined, the printing of the Manuals is a huge task and requires *over* 200 *tons of paper every year*. So many Manuals are printed that if one year's supply was placed end to end, it would extend for 125 miles. Placed one on top of the other, a year's supply would form a gigantic pile over 2 miles in height!

It is evident from the numerous letters we receive that many readers are studying languages, and this is further indicated by the great interest taken in our Guild Correspondence Club. We are sure that these Meccano boys would find the Meccano Manual very helpful in enabling them to further their knowledge of the particular language in which they are interested. A copy of the Complete Manual in any of the languages indicated will be supplied, post free, to any Meccano boy on receipt of a remittance for 2/10 (0–3 price 1/1½).

In regard to the Chinese Manuals, we have in stock a small number of an early edition. These Manuals are particularly interesting, not only because of the quaint



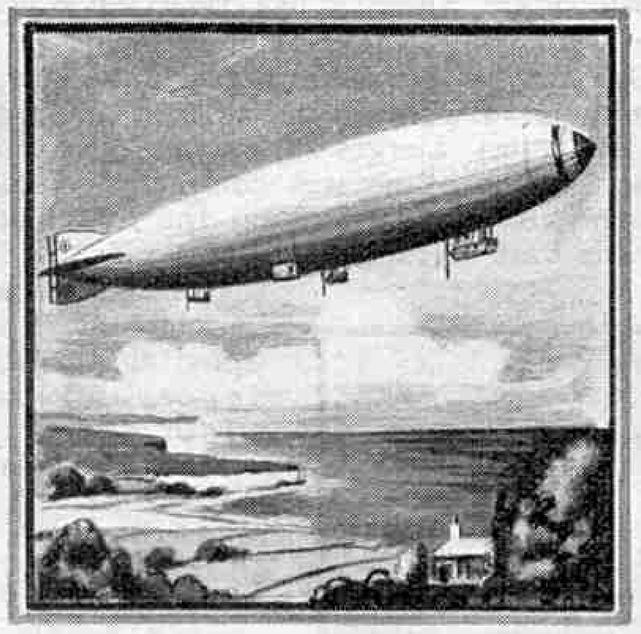
characters that are used in them but also because of the fact that the illustrations of the models are mostly reproduced from wood-cuts, a process of reproduction that is not now used in Western literature, having long since given place to the modern method of reproducing from half-tone engravings. This Manual is a novel and interesting piece of literature. A copy of this first edition of the Chinese Manual will be sent, post free, for 6d.

Meccano Limited, Binns Road, Liverpool

Oysters that Made Too Much Noise

A United States survey ship recently attempted to use a new method of determining its position while surveying off the shores of North Carolina. A small depth charge was exploded, and the sound waves from this travelled under water to several shore stations, from which the sound was automatically flashed back to the ship by wireless. Thus, by measuring with a stop watch the time from the explosion to the reception of the sound by wireless from the various stations, the distances of the ship from the latter could be calculated and the exact position fixed. The time measured was that required by the sound to travel under water, for the wireless waves, travelling with the speed of light, occupy practically no time in traversing the short distances concerned.

The attempt was a failure in this position, however, because of oysters. The delicate sound-receiving instruments placed under water registered the noises made by the bivalves in opening and shutting their shells, and these noises were reproduced with such intensity that the sounds made by the explosions were indistinguishable. It seems, therefore, that in its native element an oyster does not live up to its reputation for silence and closeness.

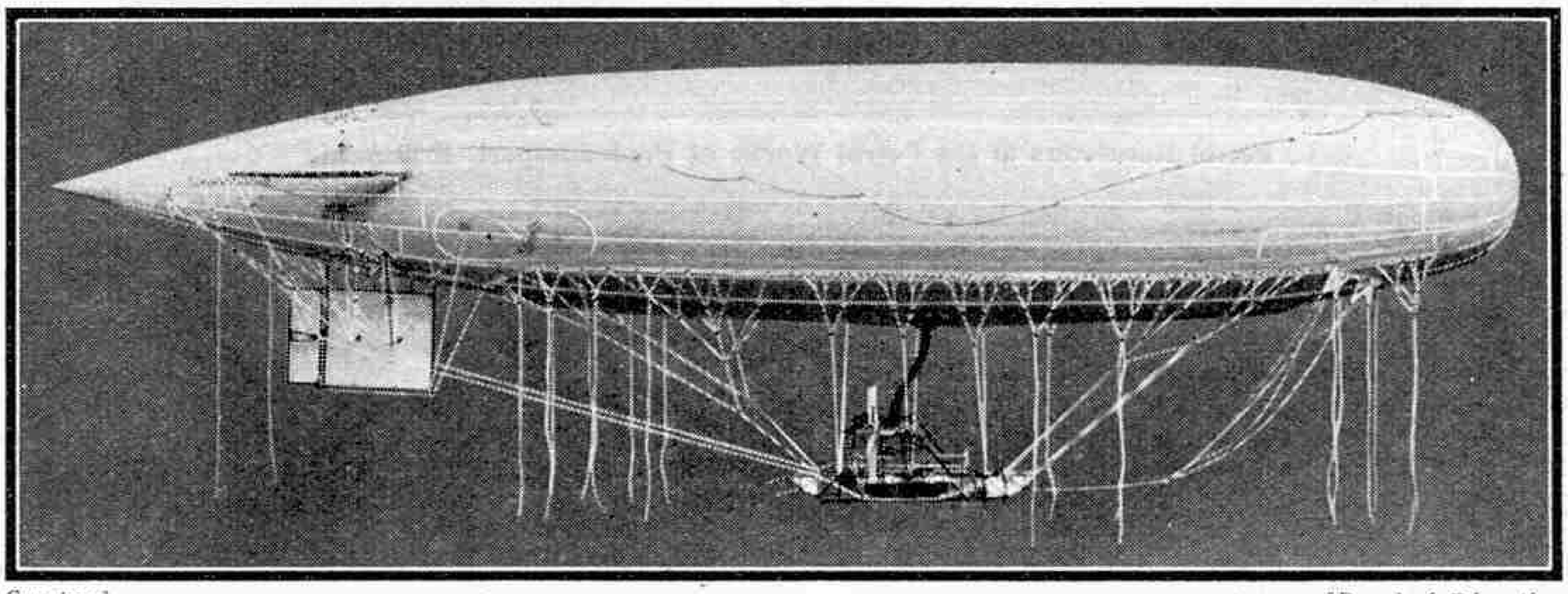


The Conquest of the Air

DEVELOPMENT OF THE DIRIGIBLE

THE attempts of early aeronauts to construct an efficient navigable airship achieved very little and when the ambitious experiments of Schwarz in 1897 ended disastrously, as described last month, it seemed as though the 19th century was to close with airships still only a subject of tentative experiments. But progress was nearer at hand than was supposed.

During 1897 a wealthy young Brazilian named Santos-Dumont visited Paris, and while there made an ascent in an ordinary balloon. The experience so thrilled him that he became an ardent balloon enthusiast and ordered two balloons to be constructed for his own use. One of these was called the "*Brazil*," and was so small that its owner was able to carry it about from place to place in his valise! This balloon was of 4,104 cu. ft. capacity and when inflated had a lifting power of about 180 lb. The envelope consisted of 135 sq. yds. of thin Japanese silk, treated externally with three coats of varnish. The other balloon could accommodate five persons, and was named the "*Vaugirard*."



Courtesy] [*Board of Education*

Photograph of model of Parseval Military Airship P.III, built in 1911 at Berlin

Santos-Dumont also became an enthusiastic rider of the motor tricycle, which was then greatly in vogue. One day it occurred to him that by applying the motive power of the tricycle engine to the balloon he could evolve a very effective airship. In the story of his life Santos-Dumont relates how at this time he resolved to construct an elongated dirigible balloon having sufficient lifting power to raise himself—representing a load of 110 lb.—" and as much more as might be necessary for the basket and rigging, motor, fuel, and absolutely indispensable ballast. In reality I was building an airship to fit my motor tricycle engine."

In a mechanic's workshop in the Rue du Colisee, Paris, Santos-Dumont adapted the motor of his tricycle for use as an aero engine and, he relates, " I realised something that was interesting in those days—a 3½ horsepower motor that weighed 66 lb."

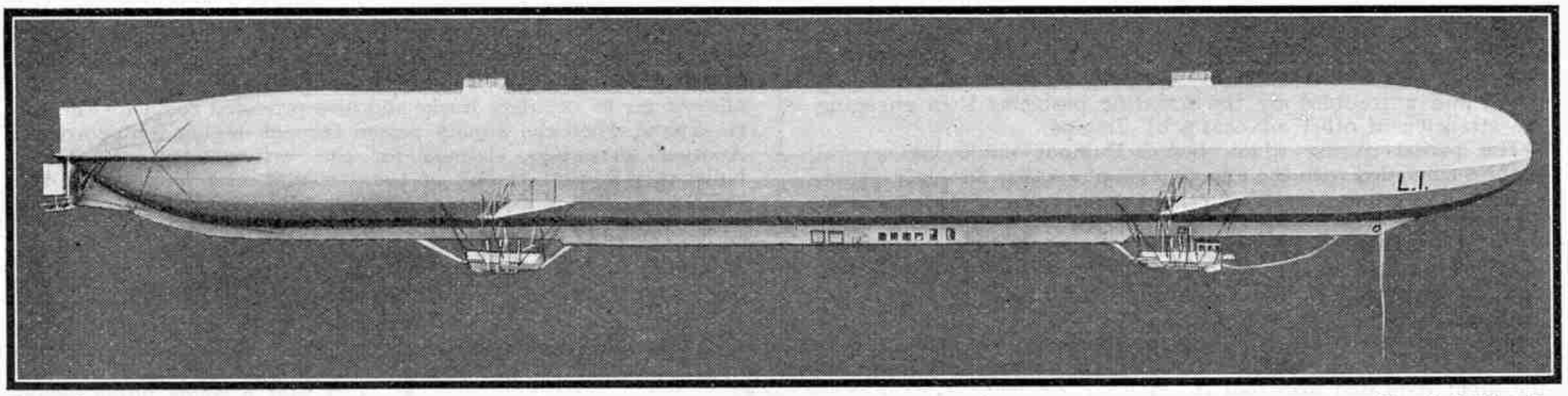
The envelope for the dirigible was constructed to his plans and was cylindrical in shape with cone-shaped ends. It was made of Japanese silk and was 82½ ft. in length, 11½ ft. in diameter, and of 6,354 cu. ft. capacity. The car was suspended beneath the envelope by means of " small wooden rods introduced into long horizontal hems sewed on both sides " of the envelope for most of its length. A rudder consisting of a triangular steel frame covered with silk was attached to the stern. Two bags of ballast were suspended from the balloon envelope, one fore and one aft. By manipulating these bags the centre of gravity of the airship could be shifted when necessary, causing the dirigible to cant upward or downward for the purpose of climbing or descending.

The trial flight of " *Santos-Dumont No.* 1," as the airship was named, was attempted from the captive balloon station at the Paris Zoological Gardens on the 18th September, 1898. Owing to the airship being placed to travel in the direction of the wind it was blown against some high trees within a few minutes of rising from the ground, and the envelope was partially torn. The damage was repaired within two days, however, and on the 20th of the same month a successful ascent was made from the Gardens.

Santos-Dumont manœuvred the airship to right and to left and up and down in order to thoroughly test the steering gear, and as this worked excellently he then elevated the airship to a height of 1,300 ft. All went well until the descent was commenced, when the gas in the envelope contracted so rapidly that the air pumps proved of insufficient capacity to compensate for the loss of hydrogen. The deflating envelope suddenly commenced to fold up in the middle like a penknife, and rendered the steering apparatus unworkable. As the airship descended with increasing velocity Santos-Dumont sighted some small boys playing in a field and shouted to them to grasp his guide rope and run with it as speedily as possible against the wind. The lads responded at once and the air resistance set up by their prompt action retarded the downward plunge of the airship sufficiently to bring the craft gently to earth. The descent was made near Bagatelle.

Early in the following year Santos-Dumont constructed his second and larger dirigible with a gas capacity of 7,000 cu. ft. A small ventilator or rotary fan operated by the motor supplemented the pneumatic air pump. This fan injected air into a " little interior air balloon which was sewed inside to the bottom of the great balloon like a kind of closed pocket."

The trial was fixed for 11th May, 1899, from the Paris Zoological Gardens, and during the morning of that day the filling of the envelope with hydrogen proceeded slowly. The airship was in the open air and while inflation was in progress the weather changed from fair to rain. Santos-Dumont decided to carry out his flight, however, and when the rain-soaked envelope was fully inflated he boarded the car and gave the signal for the airship to be released. It ascended immediately, but had not risen far before the cold, wet state of the envelope caused a considerable contraction of the gas, and the envelope shrank considerably. The airship commenced to fall rapidly, and before the air injection apparatus could be brought into use a gust of wind buckled the envelope in the middle, precipitated the airship into the topmost branches of some high trees, and wrecked it.



Courtesy] [*Board of Education*

Model of Zeppelin Naval Airship L.I, constructed in 1912

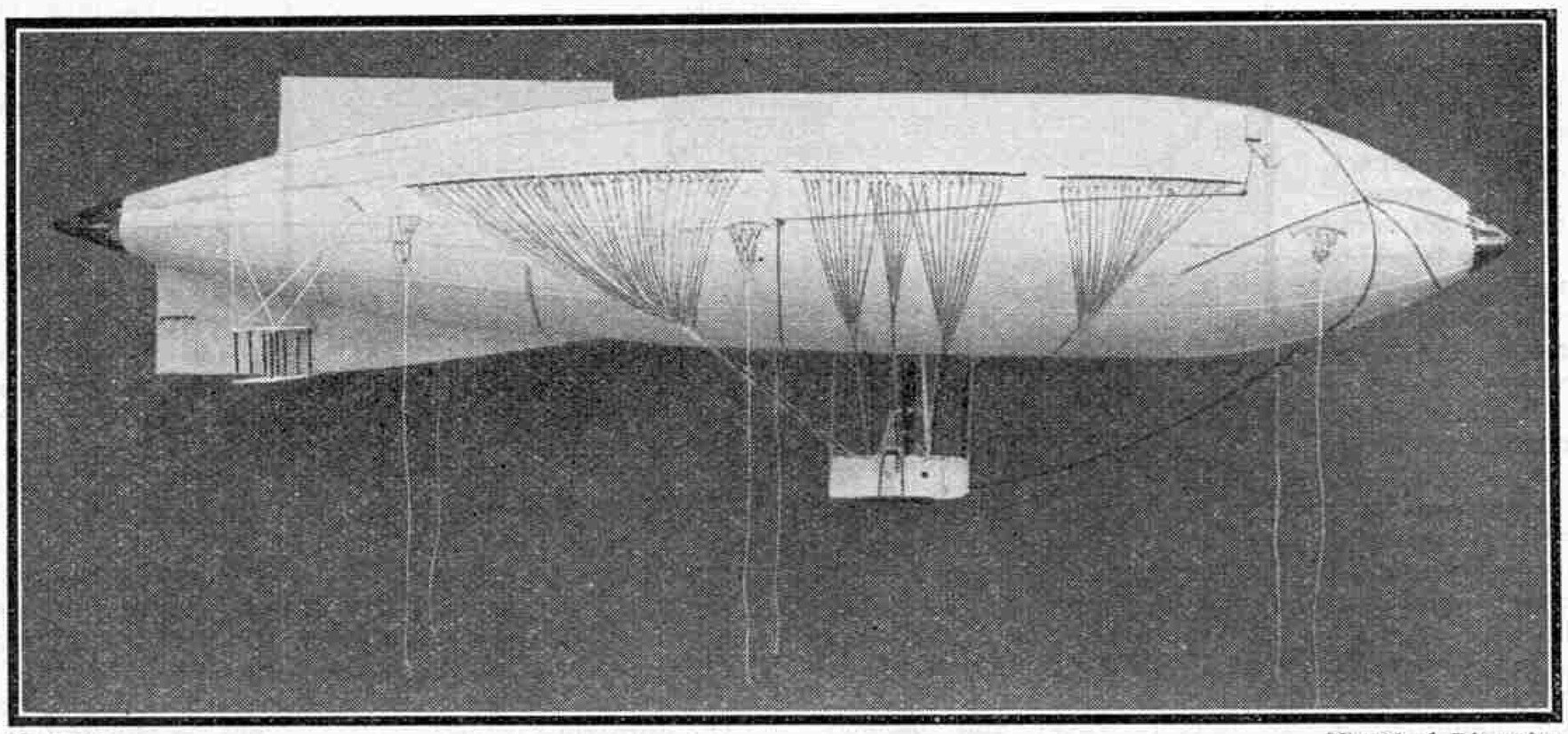
Airships Nos. 3, 4, 5 and 6 followed each other in rapid succession. After the mishap to the second airship Santos-Dumont decided to forsake long cylindrical envelopes as being inherently weak, and the body of airship No. 3 was made both shorter and thicker. It had a gas capacity of 17,650 cu. ft., which gave it double the lifting power of the previous one and three times that of airship No. 1. To leaven this increase slightly coal gas was used instead of hydrogen. The air-pump and the interior small air balloon were dispensed with. A bamboo pole, 33 ft. in length, was fixed lengthwise to the suspension cords of the car and immediately beneath the envelope to prevent the airship from buckling under sudden stress.

Several flights were made with this airship, but it failed to satisfy Santos-Dumont in regard to speed or power, and when he had erected a spacious hangar in the grounds of the Aero Club at Saint Cloud he built another ship. This was completed by the end of September, 1900, and in shape was a compromise between the first two long cylindrical airships and the shorter and rounder No. 3. It was 129 ft. in length, 17 ft. in diameter at the middle and of 15,000 cu. ft. capacity. The inventor's own description of the arrangement of this airship and its mechanism is of interest. "In it the 33 ft. bamboo pole of my No. 3 came nearer to being a real keel in that it no longer hung above my head but, amplified by vertical and horizontal cross pieces and a system of tightly-stretched cords, sustained within itself motor, propeller, and connecting machinery, petroleum reservoir, ballast, and navigator in a kind of spider web without a basket.

"I was obliged to sit in the midst of the spider web below the balloon on the saddle of a bicycle frame which I had incorporated into it. Thus the absence of the traditional balloon basket appeared to leave me astride a pole in the midst of a confusion of ropes, tubes, and machinery. Nevertheless, the device was very handy, because round this bicycle frame I had united cords for controlling the shifting weights, for striking the motor's electric spark, for opening and shutting the balloon's valves, for turning on and off the water-ballast spigots and certain other functions of the airship. Under my feet I had the starting pedals of a new seven horse-power petroleum motor, driving a propeller with two wings 13 ft. across each. They were of silk, stretched over steel plates, and very strong. For steering, my hands reposed on the bicycle handle-bars connected with my rudder."

The two-bladed propeller was fitted at the front end of the bamboo keel instead of at the stern, and was operated by the 7 h.p. twin cylinder motor at the rate of 100 revs. per minute. Several successful flights were made over Paris with this airship, one of which was witnessed by Professor Langley, of America, whose famous aeroplane experiments we shall describe when we come to deal with the history of that type of aircraft. The two-cylinder motor of airship No. 4 was later replaced by a four-cylinder one, and to compensate for the added weight the airship envelope was increased in size by inserting a new portion at the middle. A pinewood keel of triangular section was substituted for the bamboo one, while the propeller was reverted to the stern position.

The improved airship was so successful in flight that Santos-Dumont announced his intention of competing for the prize of £4,000 offered by M. Deutsch, a member of the Paris Aero Club, to the first man who should succeed in making an aerial voyage around the Eiffel Tower and returning to the starting point at Saint Cloud within half-an-hour of setting off. Santos-Dumont attempted the feat on 13th November, 1901, but an involuntary stoppage of the motor resulted in the airship falling on to the top of "the largest chestnut tree in Rothschild's garden." The airship was subsequently rescued and repaired.



Courtesy] [*Board of Education*

Model of Astra-Torres Naval Airship XIV. This non-rigid airship was designed by a Spanish engineer and built in France in 1913, for the British Navy. It performed good service in France during the Great War

A second attempt to win the prize was made on 8th August in the same year, but again misfortune intervened. A leakage of gas developed during the flight, the envelope became distorted, and rendered the steering apparatus unworkable. The basket and the long keel of the falling airship just cleared the top of the Trocadero Hotel, but the loose flapping envelope struck the hotel roof and exploded with a terrific report. The keel became wedged between the roof of a lower building and the courtyard, suspending the basket and its occupants in a precarious position. Santos-Dumont was rescued by means of ropes lowered from the hotel roof, but the airship was a total wreck. The same evening the intrepid aeronaut issued a specification for airship No. 6, and within three weeks this was built!

The sixth airship was Santos-Dumont's most ambitious effort and with it he won the Deutsch prize on 19th October, 1901, by the narrow margin of 30 seconds. The task of landing the airship occupied a further minute, however, and some controversy arose as to whether the aeronaut was entitled to the award, but by a majority vote the judges granted the £4,000 to him. The airship was of 22,239 cu. ft. capacity, and had a lifting power of 1,518 lb. The four-cylinder engine installed was of 12 h.p. "cooled automatically by the circulation of water round the top of the piston." The airship eventually came to grief during a flight over the Mediterranean from Monaco.

Seven or eight other airships were built by Santos-Dumont

in later years, but they did not represent any definite advance in construction. He remained to the end of his aeronautical career an enthusiastic amateur, revelling in the thrill of airship travel and untroubled by the scientific problems then engaging the attention of other advocates of airships.

The period during which Santos-Dumont made his several airships coincided with the experiments of another famous pioneer, a retired German army officer named Count Ferdinand von Zeppelin. In order to appreciate fully the work of this inventor we must revert to the Schwarz airship disaster of 1897. Although the flight of this airship was so brief, it was sufficient to prove that the dirigible had been constructed on sound principles and testified to the ability of the craft to carry its own car and motor. The initial stage of the flight indicated also that if a larger crew had been available to manipulate the apparatus the voyage probably would have concluded without mishap.

At the time of Schwarz's enterprise and misfortune Zeppelin was also contemplating building a rigid airship. His experience of aerial voyaging had been limited to observation duty in a captive balloon for the Confederates during the American Civil War, but when he retired from a military career he became greatly interested in the problems of aerial navigation. After considerable study he became convinced that a rigid airship was a practicable proposition, and Schwarz's experiment confirmed his belief in this respect.

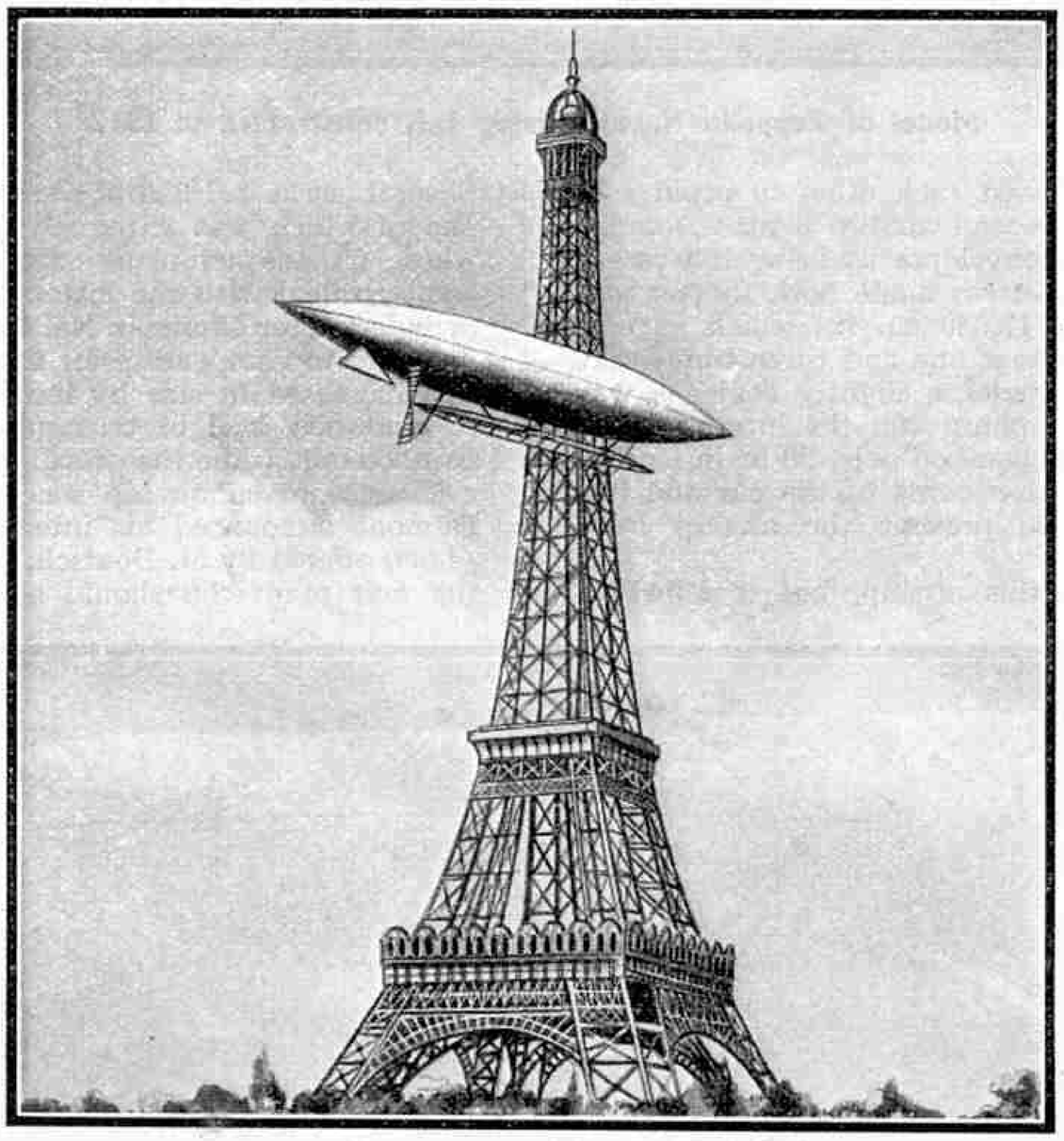
"I intend to build a vessel," he declared on one occasion, "which will be able to travel to places that cannot be approached—or only with great difficulty—by other means of transport, to undiscovered coasts or interiors, in a straight line across land and water where ships are to be sought for; from one fleet station or army to another, carrying persons and dispatches; for observations of the movement of hostile fleets or armies, not for actual participation in actual warfare. My balloon must be able to travel several days without renewing provisions, fuel or gas. It must travel quickly enough to reach a certain goal in a given number of days, and must possess sufficient rigidity and non-inflammability to ascend, travel, and descend under ordinary conditions."

Such announcements by Zeppelin were received with scepticism and some ridicule, for it was regarded as most improbable that an efficient airship could be evolved by a man who had devoted his life solely to military affairs.

Considerable funds were needed to carry out the project, but by selling his family estates, withdrawing his life savings and supplementing the money from these two sources with that of his modest army pension Zeppelin succeeded in raising £30,000. A limited liability company was then formed with a capital of £40,000, one half of which he contributed. The Emperor William II gave the scheme his royal patronage.

The airship was to be of greater length than any dirigible hitherto constructed and in order to facilitate its manipulation at the "take-off" and conclusion of flights Zeppelin decided to build and house it in a floating workshop on Lake Constance. A huge timber shed buoyed up by 95 pontoons was erected on the lake, and within this floating hangar the great dirigible was built. The strange structure on the calm waters of the lake must have occasioned much speculation among the inhabitants of the small lake-side town of Manzell, opposite to which the hangar was moored.

The airship took two years to build and when completed was 390 ft. in length and about 30 ft. in diameter. The outer envelope was of silk coated with rubber and further treated externally with pegamoid. It covered an aluminium framework comprising 17 polygonal rings spaced 24 ft. apart and linked together by longitudinal aluminium rods. The interior of this framework was divided into 16 small compartments by means of thin fabric walls. Each compartment contained a spherical-shaped hydrogen-filled balloon. The balloons did not entirely fill the compartments, and the unoccupied space in each section allowed air to circulate freely and also provided room for the gas to expand when the airship passed through higher temperatures. Another advantage claimed for this arrangement of interior balloons was that if one of them should become disabled the remaining inflated gasbags would save the airship from anything worse than sinking to a lower altitude, and a descent to earth would be compulsory only after several of the gas-bags had ceased to function. The capacity of the 16 balloons totalled approximately 12,000 cu. yds. and each inflation of the airship cost from £400 to £500. The heavy expense of filling the gas-bags was mitigated slightly by the fact that a single filling would last for almost three weeks.



Santos-Dumont on his winning flight

Two cars, each 5 ft. in breadth and 3 ft. in depth, were slung beneath the envelope, one car being situated about a quarter of the total length from the bow of the airship and the other some distance from the stern. Each car contained a 16 h.p. Daimler benzine motor that worked two propellers situated immediately above the car and attached rigidly to the body of the airship. Each propeller was capable theoretically of 1,000 revs. per min. Sufficient benzine could be accommodated aboard the cars for a ten hours' flight. Movable aluminium rudders having fixed axes and controlled by wires were fitted between the cars and the ends of the airship.

A strengthening keel constructed as a long narrow corridor linked up the cars, and carried a steel cable along which a sliding weight was made to travel by the operation of a winch. The movement of this weight shifted the centre of gravity of the airship, and affected the vessel in the same manner as the manipulation of the suspended sand bags of Santos-Dumont's first airship. By means of the sliding weight the airship could be elevated or brought low without resorting to the use of the balloon valves or discharging any ballast.

The trial flight was postponed twice owing to delays in inflating the numerous interior balloons, but by the 2nd July, 1900, everything was ready. The great airship was drawn slowly from the shed on its own pontoons and, under the control of mooring ropes, was permitted to float in the air at a height of 75 ft. above the lake. Count Zeppelin and four assistants later boarded the cars, the release signal was given and the airship began to ascend slowly. The engines were started up and experiments with the steering apparatus were carried out. Several times the rear motor stopped and temporarily rendered idle the stern propellers, but the progress of the airship was not greatly retarded by this circumstance. When Immenstaad was reached, 3¼ miles from the hangar, the airship was turned round.

The framework of the airship and the corridor warped slightly, preventing the propellers from functioning properly and causing the steering ropes to become entangled, while the winch also broke down and rendered the sliding weight unworkable. These sundry mishaps made it impossible to test the airship at full speed and the highest rate of travel achieved during the flight was 13 ft. per second. The minor accidents led to the flight being prematurely concluded and the airship was brought down again in front of the hangar, during which manœuvre slight damage was caused by fouling a pile. A further trial flight was carried out during the following month, and on this occasion a speed of 30 ft. per second was attained.

The first Zeppelin airship eventually collapsed and the construction of a better one was commenced. The work was very costly, however, and by April, 1903, Zeppelin had exhausted his financial resources. The construction of the airship was abandoned, and the plant and work were in danger of being sold when a few private friends came forward with sufficient funds to enable the

vessel to be finished. The new Zeppelin airship was completed in the summer of 1903 and embodied many improvements upon its predecessor, the most important of which was that the motor of each car was of 85 h.p. while the weight was only 8 cwt. The envelope was only 414 ft. in length, but the diameter was slightly more than that of Zeppelin I. The aluminium framework enclosed 16 compartments, the gas-bags of which contained a total of 368,000 cu. ft. of hydrogen.

The trial flight was arranged for the 30th November but once more misfortune attended the proceedings. The airship was released from the raft to which it was moored and was mounted on pontoons and taken in tow by a motor boat. A strong wind was blowing at the time and this so hurried the airship that it speedily overtook the motor boat. When it was seen what had happened the tow rope was quickly cut and the boat put on full speed and sped out of the path of the airship. The heavy rope was immediately twisted round by the disturbed water of the lake and, becoming entangled with the airship, added so much weight to its forepart that the nose became submerged.

Strenuous efforts were made to regain control of the vessel, but before this could be effected the wind caught it again and lifted it off the pontoon. The propellers then came into action with the result that the airship, still canting downward at the forepart, shot once more nose first into the water. The damage sustained was so serious as to cause a delay of six weeks before the vessel was again fit for trial.

On 17th June, 1906 it was once more towed to a suitable location on the lake and a successful take-off effected. In the course of this flight the airship attained a height of 15,000 ft. During the concluding stages a strong wind carried the airship over the shore, but a descent was made with no other damage than a slight rent in the envelope caused by friction against a tree. The airship was left anchored to the ground during the night, but it suffered so much from the effects of the high wind that prevailed that, after inspecting it next morning, Zeppelin gave orders for it to be broken up. Thus the second Zeppelin airship came to an unfortunate end.

Further Zeppelins were built, each equipped with motors of greater power than its predecessor, and improved in various minor details. They demonstrated so convincingly the reliability of this type of aircraft that airship services eventually came into being in Germany, and at the time of the outbreak of the Great War in 1914 provincial airship travel was well established in that country.

Zeppelin did not confine his attention to developing efficient passenger-carrying airships, for he recognised their enormous possibilities in warfare, and the illustration on page 399 shows the naval airship " L.1 " that was designed and built under his supervision in 1911. He remained a faithful adherent to the principle of a rigid framework enclosing a series of gas-filled " ballonets," and the L.1 contained 17 small hydrogen-filled balloons. The airship was 514 ft. in length, 47 ft. in diameter and of 776,600 cu. ft. capacity. The three Maybach engines housed in the cars gave a total of 540 h.p., and a speed of roughly 50 m.p.h. was attained under favourable weather conditions.

The sliding weight arrangement included in the first Zeppelin was superseded in " L.1 " by two pairs of plane-sets, one forward and the other astern. Each set comprised four parallel planes attached laterally to the first polygonal ring of the airship framework. The two cars beneath the envelope were connected by a rigid girder keel, encased in rubbered cloth. The forward car contained the controls, navigation instruments, and two power units, while the rear car housed one power unit. Two platforms mounted on the top of the airship provided facilities for the firing of long-range machine guns, while similar guns were accommodated in the cars.



Alberto Santos-Dumont

The success of the Zeppelin airships brought the rigid type of construction into high favour but the non-rigid as employed by Santos-Dumont was not entirely neglected. In the year following the construction of the Zeppelin Naval Airship L.1 a huge non-rigid airship was constructed at Berlin to the design of Major von Parseval. This vessel was 272 ft. 4 in. in length, 52 ft. in diameter at the widest part and of 388,450 cu. ft. capacity. It was driven by two Körtling engines each of 200 h.p. and could attain a speed of 42 m.p.h.

The ascent or descent of the airship was effected by the manipulation of two small air-balloons, situated one in the prow and one in the stern of the airship envelope. To tilt the nose of the airship upward for climbing, air was pumped into the rear balloon which, as it expanded, forced the gas in the main envelope to the forward end of the airship and thus caused the prow to lift. To effect a descent the rear air-balloon was deflated and the forward one filled, with the result that the gas was driven into the stern, and the prow of the airship canted downward. The single car was carried by means of suspension cords, distributed over a large portion of the airship's envelope in order to equalise the load. The illustration we give of a model of this airship shows clearly this arrangement and also the situation of the large rudder and horizontal side-planes.

World's Largest Bridge—

(*Continued from page* 371)

As already noted three of the greatest suspension bridges in the world span the East River, but the honour of having the longest suspended span in the world belongs to-day to the Delaware River Bridge, which connects Philadelphia, Pa., on the west side of the river, with Camden, N.J., on the east bank. It has a centre span of 1,750 ft. and is 3,450 ft. in length over the cable anchorages. The new Hudson River Bridge will have a central span of 3,500 ft.—just twice the length of the Delaware River Bridge span!

The Hudson River Bridge is planned to be built in two stages. The first stage will provide a single roadway to accommodate four lines of vehicular traffic and two passenger sidewalks. Subsequently this roadway will be widened and a lower platform will be constructed, the complete bridge then having accommodation for eight lines of vehicular traffic and footwalks on the upper roadway, and for four (or more) lines of high speed transit tracks on the lower roadway.

The total length of the bridge from anchorage to anchorage will be 4,800 ft., the shore spans each being 650 ft. in length from the main supporting towers to the anchorages. The towers will extend to a height of 650 ft. above water and the weight of the suspended structure will be 120,000 tons. The plans propose the use of cables consisting of eyebar chains instead of wire cables. If eyebar cables are used the vertical load on the towers will be 140,000 tons or 115,000 tons if wire cables are employed. The total load on the foundation will be 350,000 tons, and the estimated total weight of the whole structure, including anchorages, towers, cables, road systems, etc., is about 1,000,000 tons.

On the New York side the anchorage will consist of a mass of concrete weighing 370,000 tons and on this side the approach will consist of huge granite arches. On the New Jersey side the entrance will pass through a cutting 50 ft. in depth, spanned by a massive masonry bridge with one large central arch and two smaller side arches.

It is hoped that the bridge will be completed in 1932, and it is estimated that during the first twelve months of its career it will afford passage to nearly 9,000,000 vehicles and nearly 1,500,000 pedestrians. Looking still further into the future, the prophets calculate that these figures will be more than doubled by 1960!

This article is a continuation of a series in which we have dealt with some of the famous bridges of the world, including Waterloo Bridge, the Forth Bridge, Sydney Harbour Bridge, Brooklyn Bridge and the Delaware Suspension Bridge. This series is to be continued and will include another article on the Hudson River Bridge when sufficient progress has been made with its construction.

The Flettner Rudder

Steering a 10,000-ton Ship by Hand

By H. F. Lane

In next month's "M.M." we shall describe a very interesting Meccano model of the Flettner Rudder, built by our contributor, and this article describes briefly and clearly the principles of this wonderful invention. Those readers who intend to build the model should read this article very carefully and keep it by them for future reference.

THE remarkable invention known as the Flettner rudder has now been fitted to a number of vessels of various types.

If fitted to vessels of any size up to 10,000 tons, the Flettner rudder may be controlled by hand, without the aid of any engine or other auxiliary steering device. In larger ships the rudder can be controlled with the aid of an engine of very small power; in fact, even in the largest ships an electric motor of ½ h.p. is all that is necessary.

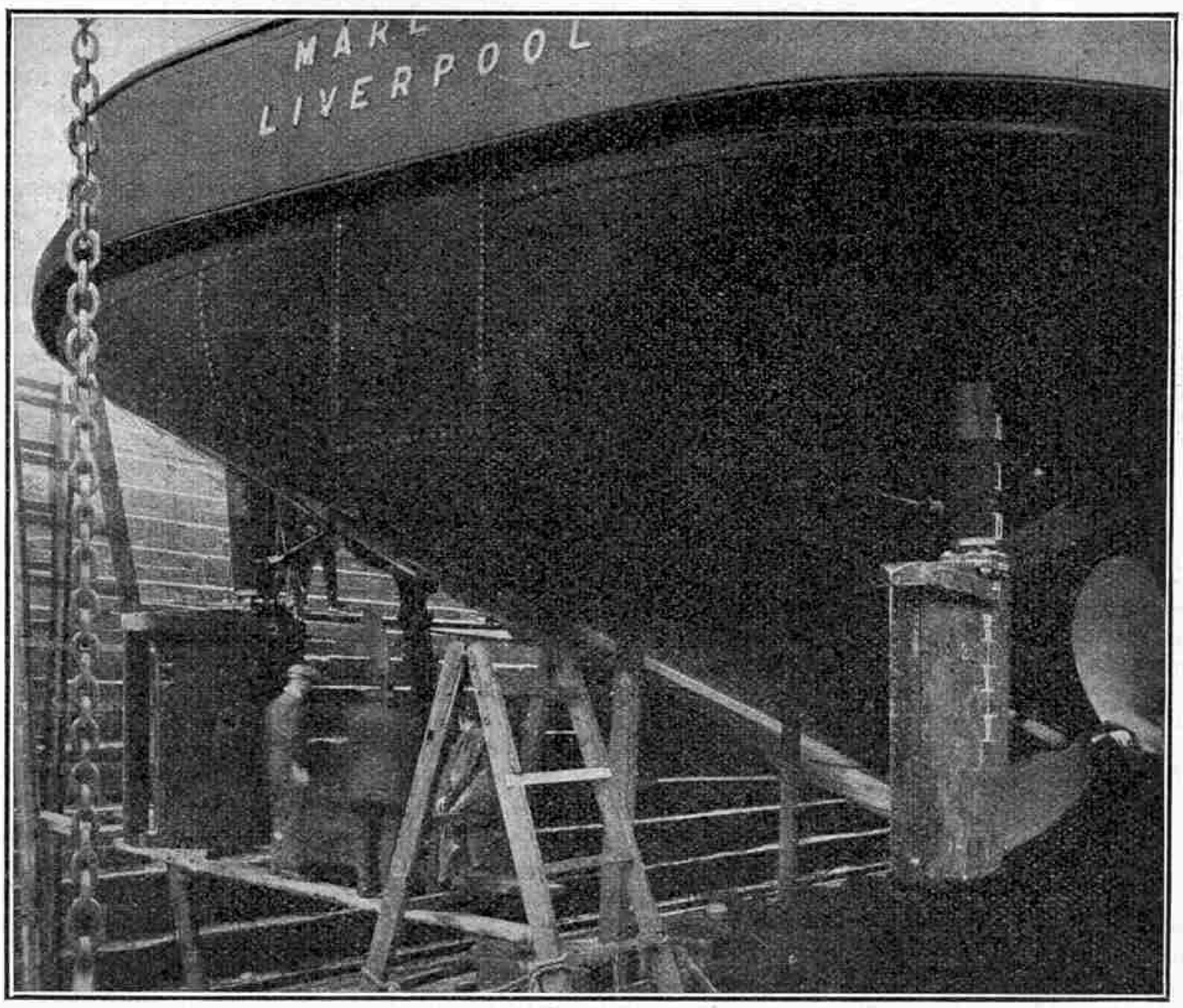
In a ship of any considerable tonnage, or in a small ship intended for high speed work, such as the destroyers of His Majesty's Navy, the steering engine often is required to develop as much as 1,000 h.p. if the ordinary type of rudder is used. When it is considered that in the vast majority of instances a steam engine performs this duty and has to work under the most uneconomic conditions, because hunting gear* can operate only with lapless valves, it can easily be realised that the fuel expenditure involved merely in steering the ship forms no small proportion of her total running cost. In view of this the Flettner rudder is claimed by its inventor to effect a very considerable saving in initial cost, in space and in maintenance. It is also claimed that, owing to the nature of its control, ships fitted with the invention gain in manœuvring power and suffer less from the retarding effect caused by helm.

The Flettner rudder makes use of the pressure set up by the flow of water past the ship to operate the rudder, the effect of the flow being controlled by a small secondary rudder attached to the trailing edge of the main rudder. The latter is of the balanced type and is free to rotate completely, and the secondary rudder is controlled by the helmsman. Thus the small rudder steers the large rudder and the large rudder steers the ship.

It is interesting to note that the inventor's principle of using the current itself to operate the rudder was first put into practice on large German aeroplanes during the War. In aircraft it is essential that the ailerons be controlled by hand and in the case of large machines, where it is necessary to move considerable areas, the Flettner invention proves a very real boon. The flow of air past the ailerons of an aeroplane is similar in effect, of course, to the flow of water past a ship's rudder.

To make the principles of the Flettner rudder clear a brief explanation of rudder effect is necessary. When the water round a rudder is stationary relative to it, there can be no rudder effect, whatever angle the helm may be put to. But when the ship is under way, there is a constant stream of water flowing past the rudder due to the passage of the ship through the water, and this is intensified many times by the wash thrown aft by the screws. If the rudder is placed at an angle to the stream, the water is deflected by it and forced over to one side, thereby setting up a reaction which forces the stern of the ship to the opposite side, so turning the vessel.

Provided that the face of the rudder remains in the stream at any angle, the actual point round which it pivots is immaterial within certain limits. In former days rudders pivoted round their leading edge, down the whole length of which they were attached by bearings to the ship's frame. But as the size and speed of ships increased, the power required to turn and hold the rudder against the pressure of the water became considerable, necessitating heavy construction and very powerful steering engines. Accordingly, in order to make steering easier, the "balanced" rudder was introduced, i.e., a rudder having a portion of its area on each side of the pivot. Each rudder shown in Fig. 1 is of the balanced type, and it will be seen that the stock is attached at a point some distance from the leading edge.



Courtesy [*Harfield & Co. Ltd.*

Fig. 1. Flettner Rudders fitted to the Mersey Ferry Boat "*Marlowe*"

In a balanced rudder the stream of water impinges on an area of the rudder in front of the pivot and also on an area behind the pivot; this has the effect of each area tending to turn the rudder in a different direction without lessening the deflection of the stream. Consequently the control has only the excess of one turning moment over the other with which to contend. In the extreme case, with the areas absolutely equal, the rudder would theoretically be in equilibrium at any angle. This extreme is not found in practice, owing to a number of causes which need not be gone into here.

Consider now a rudder pivoted nearly centrally, that is, with one area only slightly in excess of the other, and capable of rotating perfectly freely in either direction like a weather cock. When the ship is moving in a straight line through the water, the slightly larger area on the after portion will keep the rudder in the fore and aft line. On the other hand, only a very small force will be required to deflect the rudder to any angle and hold it there, while the force that it will exert tending to turn the ship is no

* *See "A Meccano Demonstration of Hunting Gear," by H. F. Lane, page 756, December 1926, "M.M."*

less than if it were pivoted in the old way by its leading edge.

With the main rudder so nearly in perfect balance, almost any size of vessel could be steered by hand. In practice, however, various considerations prevent the rudder areas exceeding a certain ratio to each other, and consequently power to overcome this lack of balance is needed, though only a fraction of that required for the old completely unbalanced rudder. To supply this power, the Flettner method makes use of the stream of water impinging on the auxiliary rudder mounted on the trailing edge of the main rudder, and thus dispenses with the need for mechanical power on board altogether. In other words, the main rudder is itself steered by the auxiliary rudder.

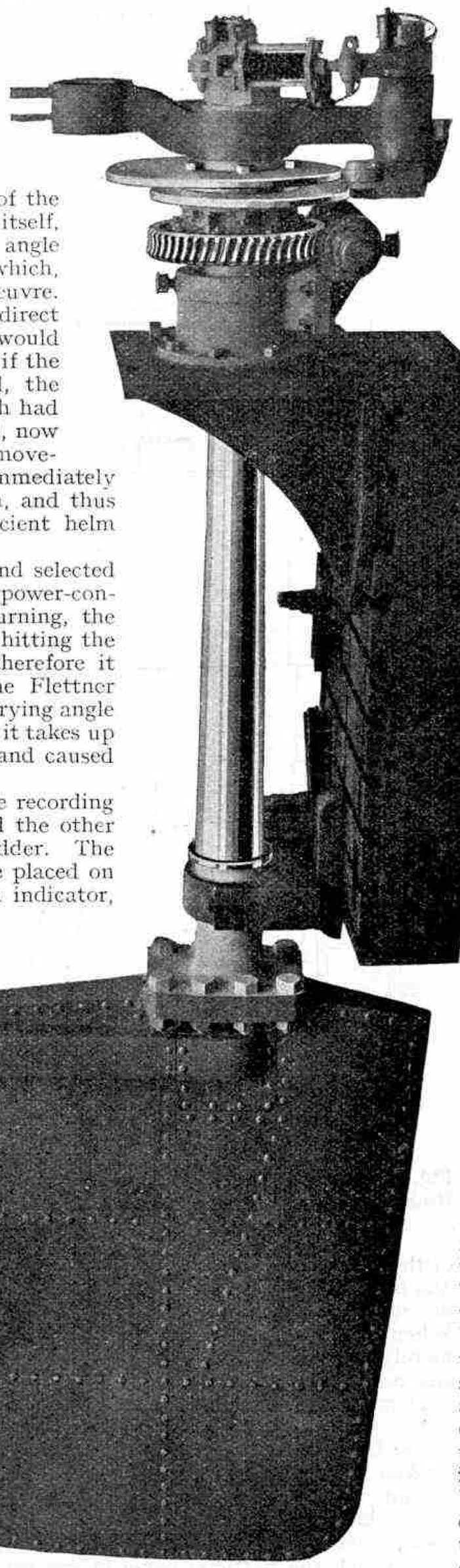
But great saving of power is not the only advantage of the Flettner rudder. As a result of the principle, the main rudder is continually setting itself, as the direction of the stream changes, to the angle that will be most effective in steering the ship, which, in consequence, becomes much more easy to manœuvre. For example, if the main rudder were operated direct and the helm put over 20 degrees, the main would remain at 20 degrees throughout the turn. But if the same angle be placed on the Flettner control, the moment the ship starts to turn the stream, which had previously been flowing along the line of the keel, now comes across it obliquely, and without further movement of the steering wheel the Flettner immediately adjusts itself to this new direction of the stream, and thus maintains itself automatically at the most efficient helm angle.

This setting is far too delicate to be gauged and selected by a quartermaster using a directly-operated, power-controlled rudder, for it depends on the rate of turning, the loss of speed due to turning, the effect of waves hitting the ship, yaw, and numberless other causes, and therefore it is continually varying. On the other hand, the Flettner must continually set itself automatically to this varying angle in its efforts to seek equilibrium, since the position it takes up relative to the control is directly dependent on and caused by the direction of the stream striking it.

There are two indicators on the bridge, the one recording the angle to which the control has been set, and the other recording the position taken up by the main rudder. The helm orders given by the officer of the watch are placed on the control. But for the existence of the main indicator, the quartermaster would not know the exact position taken up by the main rudder. When adjusting the position of the rudder, however, he disregards the main indicator and merely maintains the control at the helm angle ordered, except when the direction of the engines is reversed, as will be explained next month.

It may make matters clearer to mention that if the ship were at rest or in dry dock, the main rudder would remain stationary in any position, or by a very small applied pressure it could be spun round and round like a vane. Under these conditions a movement of the control will have no effect on the main rudder at all.

Having dealt briefly with the principle of the Flettner rudder, the conditions which have to be fulfilled by the mechanical control can now be set out. They are as follows :—



Courtesy [*Harfield & Co. Ltd.*

Fig. 2. Flettner Rudder, complete with Control Gear

(a) The operating gear must transmit the movement of the steering wheel to the secondary rudder.

(b) (1) This movement must be variable, that is, for small angles there must be a bold, rapid movement of the secondary rudder to produce a definite and instantaneous effect on the main rudder, and

(2) there must be critical points at which an increase of the angle of the main rudder relative to the fore and aft line of the ship reverses the angling produced on the secondary, and causes the angle between main and secondary rudders to diminish.

(c) The operating gear must maintain the relation between the secondary and main rudders so that

(1) should the main be deflected by outside agency, such as a wave, the angle of the secondary alters automatically and restores the main to its original position.

(2) When the ship goes astern, the change in the direction of the stream will rotate the main 180 degrees. The control must still operate under these conditions, without reversal of direction. For example, to give starboard helm, the wheel must be put over in the same way as it would be to get starboard helm when going ahead.

These requirements are met by a form of double "hunting-gear" operated by a rocking arm, a system of links, and two cams.

In addition, there is the Board of Trade requirement that the rudder of any merchant ship must be capable of being operated directly and by hand, as a precautionary measure against accidents. This is effected by a toothed quadrant, acting directly on the main rudder, with which can be engaged a pinion that is operated by the hand steering gear. A point that should be noted is that the greater degree of balance of the Flettner rudder permits of a much lighter hand gear and less reduction than is the case with the ordinary rudder.

Fig. 2 shows a Flettner Rudder unit complete with control gear, etc. The main rudder is mounted on a stock that is carried in bearings secured to the stern frame in the usual way, but as no tiller or other such device is fitted the rudder is free to rotate completely, sufficient clearance round the propeller being given to allow of this.

In practice the main rudder is of stream-line section and the auxiliary rudder is also balanced. The actual proportions of main and auxiliary rudders and the point of attachment of the stock have been determined experimentally from models tested in the experimental tanks. From these researches it has been established that the best proportion of the auxiliary to the main rudder is as 1 : 8.

The main rudder is of the built-up type and is formed from a central casting of steel with welded stiffening pieces to which the outer plates are riveted. The rudder stock is journalled in two sets of ball bearings and above the upper bearing, which is just above the deck, a bronze worm wheel is mounted loosely on the rudder stock. This worm wheel is in engagement with a worm that is operated from the bridge steering wheel by means of bevels and shafting. Mounted on the worm wheel is a boss carrying two specially shaped cams, the object of which is to transmit angular movement to the auxiliary rudder. A double-armed quadrant, or tiller, is keyed to the upper end of the rudder stock and a rocker arm is mounted on a spindle journalled in a bushed bearing at one end of the tiller arm. Rollers on each end of the rocker press on the periphery of the cams. To the upper end of the spindle carrying the rocker a crank is secured and connected to another crank mounted on the top of the control shaft, which passes down through the centre of the hollow rudder stock and is connected to the auxiliary rudder by yokes and links inside the main rudder. A spring buffer link is inserted between the cranks to absorb any shocks imparted to the mechanism when the rudder is in service.

Interesting examples of the use of Flettner rudders are to be found in the new Mersey ferry boats, the T.S.S. "*Wallasey*" and "*Marlowe.*" These boats are specially designed for use in

connection with the passenger ferry service between Liverpool and Seacombe, Cheshire, and they represent the very latest examples of this type of vessel. The rudders were the first of their type to be manufactured in Great Britain to the Board of Trade and Lloyd's requirements.

The two vessels were designed and built by the Caledon Shipbuilding and Engineering Company Ltd., of Dundee, and they are 158 ft. in length by 48 ft. in width. They are fitted with twin screws and triple-expansion steam engines, with a total output of 1,200 I.H.P. Each vessel has a passenger carrying capacity of 2,233 persons.

Both the new vessels can be brought away from the landing stage with considerably greater ease and expedition than is the case with the sister ships equipped with ordinary rudders and steam steering gear. With the latter vessels it is usual to put the helm hard over with only one propeller at work when getting away from the landing stage, but in the case of the Flettner-equipped "*Marlowe*" and "*Wallasey*" both engines may be set running ahead whilst the helm is put hard over in the required direction, the speed of the engines being increased as the vessel leaves the stage.

Extremely satisfactory results are given regarding the daily performance of the two new vessels. It is stated that the economy resulting from the absence of steam steering gear, taken in conjunction with the efficient propelling machinery, amounts to approximately one ton of coal per day for the two new ships, notwithstanding the fact that these boats are capable of carrying some 500 passengers more than the next largest boats employed on the Mersey ferry service.

There are at the present time several cargo and passenger ships in service having Flettner equipment. These vessels range in size from 160 to 9,000 tons deadweight and all are steered entirely by hand direct from the bridge.

In addition to these vessels there are also in service various small tugs and some hundred Rhine barges ranging in size from 270 to 3,000 tons deadweight fitted with the invention. Prior to the provision of the Flettner rudder, the barges were steered by a horizontal wheel and in certain parts of the river they required as many as four men to control them. As a result of fitting Flettner rudders they are now quite easily handled by one man.

The rudder has proved its efficiency both in single screw and twin screw ships. It gives superior manœuvring power when compared with the usual rudder, and under normal conditions offers no more resistance to the passage of the vessel through the water. At extreme angles of helm, it is far more efficient in action than a normal rudder and offers much less resistance to forward motion.

No doubt most "*M.M.*" readers know that when a ship turns under helm her motion through the water becomes oblique and she develops a "drift angle." This drift angle, or the angle between the centre line of the ship at any point, and the direction of motion of the same point, is greatest at the stern. Now the Flettner rudder, being operated by the surrounding water only, sets itself at the angle desired by the helmsman, not with the centre line of the ship, but with the direction of flow of the surrounding water. There is in this case, therefore, no difference between the effective helm angle operating and the angle desired by the helmsman. It is considered that this advantage largely accounts for the remarkable results obtained with the Flettner rudder.

With an ordinary balanced rudder, that is, one which is slightly under-balanced for motion ahead, a very heavy torsional stress is produced when the ship goes astern because the centre of pressure is much further from the stock. With a Flettner rudder, no torsional stresses in the stock can occur at any time since the sum

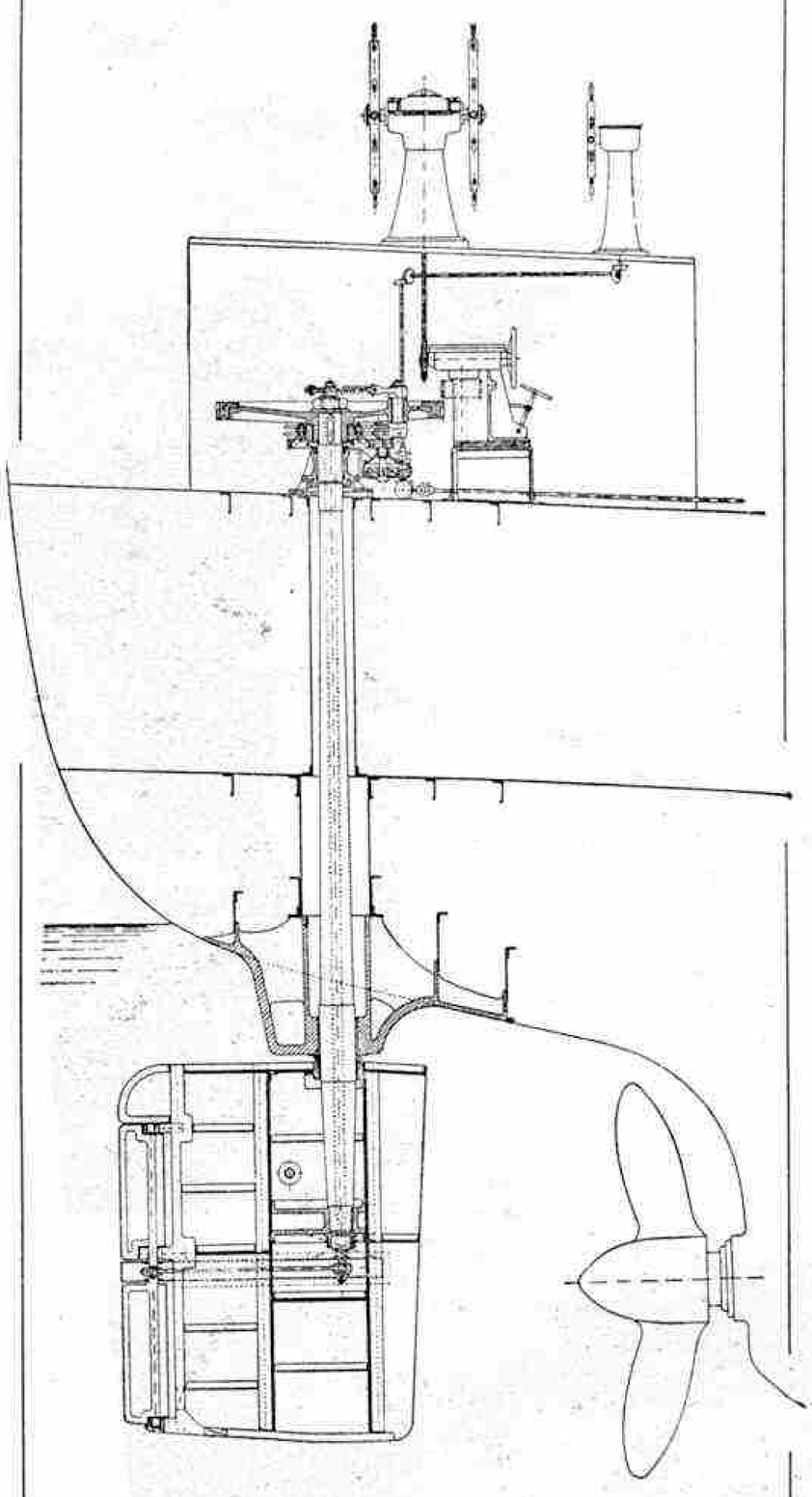


Fig. 3. Drawing showing complete Flettner Rudder installation, with emergency hand steering gear

of the moment of pressure of the auxiliary and main rudders about the stock is always nil when the rudder is in equilibrium. When it is not in equilibrium the torsion is merely expended in moving the rudder and not in twisting the stock.

Damage to ordinary rudders due to heavy seas is of quite common occurrence. Apart from the energy in moving masses of broken water on the surface, the orbital motion of the wave particles themselves is capable of dealing heavy blows to any fixed object, such as an ordinary rudder, with which the particles come in contact. The Flettner rudder, being free to rotate away from any such external pressure, is extremely unlikely to receive any damage therefrom. It is just conceivable that the centre of effort of a blow from a wave might coincide with the axis of the stock, in which case a heavy bending moment might be induced. This, however, could only occur if the blow were received from a wave on a part of the rudder only.

In a similar way the Flettner rudder is much less likely than an ordinary rudder to be damaged by sunken wreckage. If the rudder is at any time deflected by a blow from an external source, the operating gear of the auxiliary rudder is so designed as to give the requisite motion to that rudder to restore the main rudder to its original angle without conscious effort on the part of the helmsman.

When an ordinary rudder is used to reverse a turn, or in other words, to change the course of a ship from, say, a curved path to starboard to a similar movement to port, the streams impinge on the rudder at a much larger angle than the apparent helm angle. For example, if the ship is following a curved path and the helm is put over say 20 degrees to change her course, the effective helm angle may be as much as 80 or 90 degrees, which means that most of the energy given up by the water on striking the rudder will be used to check the speed of the vessel and very little to turn her. Here again the Flettner rudder places itself at the desired angle to the stream lines and so produces the maximum turning effect and a much smaller retarding effect.

Considerable economy is derived from the fact that in Flettner rudder equipped vessels no steering engines are required. Therefore no fuel is used for steering, and no allowance need be made for wear and tear on steering engines.

Owing to the absence of steering engines, extra space is available that can be used for other purposes. The deck is free from chains, in cases where these would otherwise be used, whilst the operating gear on the rudder head is contained in a small and compact housing and takes the place of a large and cumbersome quadrant.

The drawing reproduced on this page shows the general layout of the equipment in a vessel fitted with a single Flettner rudder. The emergency hand steering gear, which is shown mounted immediately above the operating gear housing, may quickly be coupled up by bringing a pinion into engagement with the main toothed quadrant incorporated in the Flettner mechanism.

Owing to the favourable degree of balance of the rudder and to the corresponding reduction of load, the emergency gear, etc., can be constructed much smaller and lighter than would be possible with a normal rudder. Under emergency conditions, therefore, the Flettner rudder can be operated more easily than the ordinary type of rudder; furthermore it has the advantage of a smaller turning or twisting moment than the normal unbalanced type of rudder.

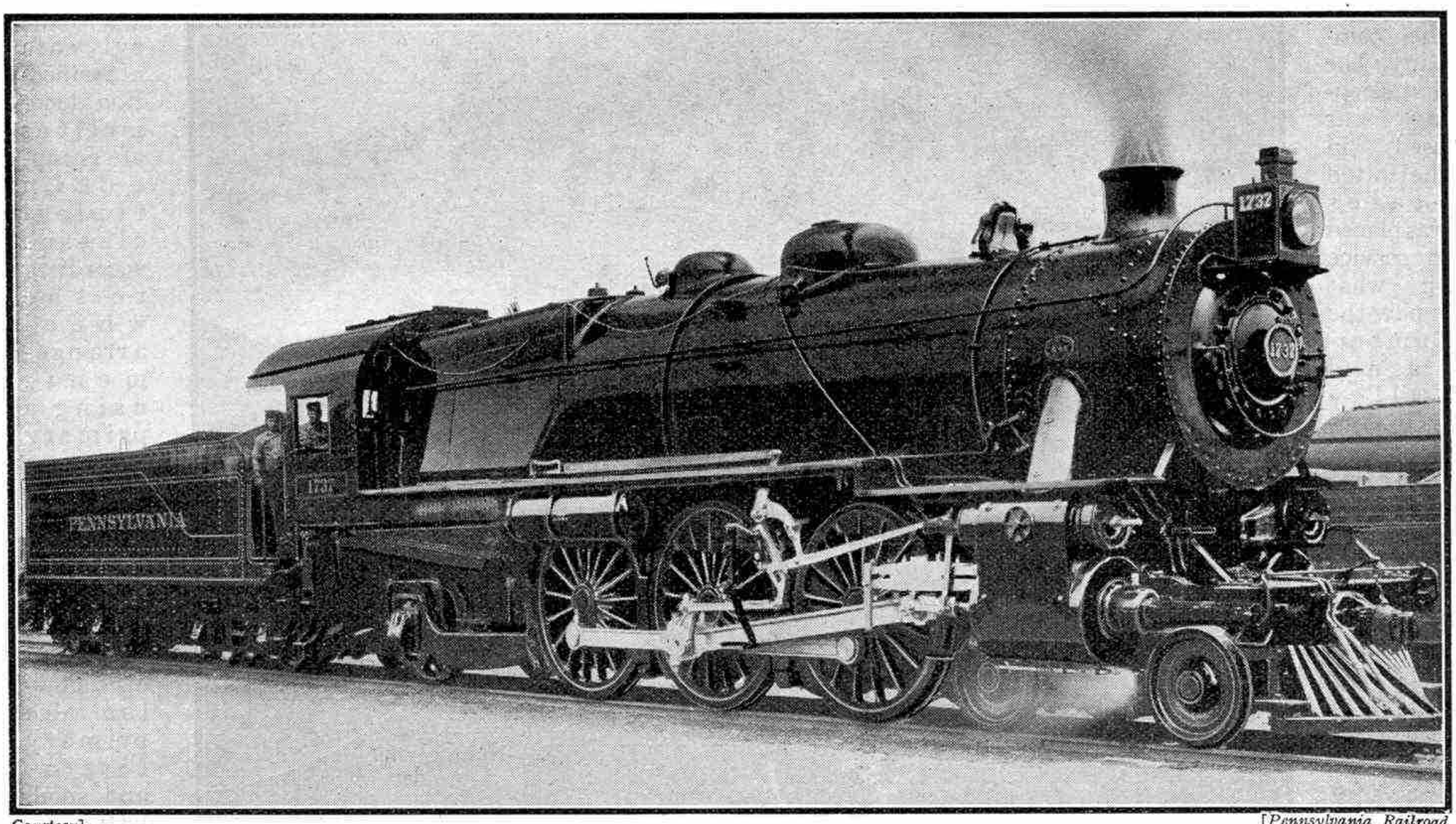
The important advantages of the rudder as to its performance in comparison with rudders of the normal type have been demonstrated on many occasions. Apart from the satisfaction given in ships owned by British, Dutch, German and Scandinavian owners, the rudder has proved itself of great value in the navigation of confined and crowded waterways, where speed of manœuvring is of the greatest importance. It is probable that many collisions that have occurred in such waterways might have been avoided if the vessels had been capable of quicker turning movements.

There seems to be little doubt that the very definite superiority of the Flettner rudder will lead to the extensive adoption of the system to ships of all classes in the near future.

America's Largest Freight Carrier

The Pennsylvania Railroad

By Henry H. Humphries



Courtesy] [*Pennsylvania Railroad*

Standard Heavy Duty Passenger Locomotive, "Pacific" type, Class K-4s. Cylinders 27 in. diameter, 28 in. stroke; Steam Pressure, 205 lb. per sq. in. Driving Wheel Diameter, 80 in.; Weight on Driving Wheels, 201,830 lb.; Total Weight of Locomotive and Tender in Working Order, 480,290 lb.; Tractive Power, 44,460 lb.

OF the many railroad systems in the United States of America the most remarkable and extensive is the Pennsylvania Railroad. Originating in the state of Pennsylvania, this company has gained control of lines through other States by purchase or lease, and has further expanded by building new lines, until at the present time its system comprises 11,672 miles of road and 27,663 miles of total trackage, including double, quadruple and six track, etc., and company sidings. Its lines traverse the States of New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, West Virginia, Ohio, Indiana, Michigan, Illinois, Kentucky and Missouri, and the District of Columbia.

The Pennsylvania Railroad is the greatest carrier of freight and passenger traffic in the United States, its contribution to the public service in 1925 being equivalent to moving one ton of freight a distance of 45 billion miles and to moving one passenger a distance of almost $6\frac{1}{2}$ billion miles.

In order to perform this gigantic task in transportation, hundreds of trains are moving over the railroad every hour of the day and night and, in view of the service it performs, it is not surprising that the company owns more passenger and freight cars and more locomotives than any other railroad in the country.

For over a generation the Pennsylvania system has occupied a unique position in the field of transportation, differing in important respects from that of any other system. Few other roads have extended their lines to cover a greater area of territory and to reach more widely separated terminals. This self-contained system traverses the great central belt of the country, a region for more intensively developed than any other within the national boundary. It may be described roughly as extending from the Great Lakes and the Canadian border into the Southern States, and from the Mississippi River to the Atlantic seaboard.

The lines of the system are not only counted among the principal highways joining east and west, but north and south they extend from the land of spring wheat to the land of cotton. The 13 States constituting this territory include within their limits practically every range of climatic conditions found in the United States, with the exception of sub-tropical and desert, and embrace or border upon practically all the great historical groupings of the population. Within these limits live approximately half the entire population of the United States, and by far the majority of the country's industrial, commercial, agricultural and mining concerns are concentrated in the territory traversed by the Pennsylvania lines.

The Pennsylvania system has been more closely identified with the growth of this central territory than any other railroad, and the result has been to throw

upon its lines a greater volume of traffic, measured in tons of freight and passengers carried per mile, than is handled by any other transportation system, not only in the United States, but in the whole world. In addition it has been to a large extent a pioneer railroad, and has introduced many practices that are now standard.

The Company was the first to introduce in the United States the use of steel rails, the first order having been placed in England in 1862, by J. Edgar Thomson, then president of the company. The first sleeping car used in theUnited States wasplaced in service on what is now the Cumberland Valley Division, between Chambersburg and Harrisburg, Pennsylvania, in 1837; and the first train equipped with air brakes was the "*Steubenville Accommodation*," operated out of Pennsylvania Station, Pittsburg, in 1868. In addition the company was first to adopt, in 1906, all-steel construction as standard for all types of passenger equipment cars.



Courtesy] [*Pennsylvania Railroad*

Aeroplane View of the Horse Shoe Curve

The policy in regard to the development of motive power and cars has been conservative, in that new types or designs have never been introduced until investigation and trial had proved fully their fitness for the particular service they were intended to perform. On the other hand, expenditure has been liberal when the advantages of using new designs or more expensive materials were proved to the management. In this, as in other fields of progress, the Pennsylvania has shown the way in America. In this connection it is important to bear in mind that the Pennsylvania, with its 11,672 miles of road, operates under very different conditions in various parts of the country, and therefore different types of locomotives adapted to performing different kinds of work have necessarily been evolved.

In 1926 the company had in its equipment a total of 7,347 locomotives, constituting 11.55 per cent. of the aggregate number of locomotives owned by all Class 1 railroads in the United States. It has 271,218 freight train cars, or 11.26 per cent. of the total, and 8,121 passenger train cars, or 14.87 per cent. of the total.

Locomotives are classified according to a system peculiar to the Pennsylvania Railroad, as well as on the Whyte system, which is in general use. The Whyte system, based on the representation by numerals of the number and arrangement of the wheels, is familiar to all "*M.M.*" readers, who are aware, for example, that a "Pacific" type locomotive with a four-wheeled leading truck, three pairs of driving wheels and two trailing wheels is described as being of 4–6–2 type. In the Pennsylvania classification locomotives are grouped in typical classes according to the wheel arrangement, using a primary letter to indicate the type. Successive designs of a type are designated by numerals following the primary letter, and small letters indicate modifications of a particular class of locomotives. The suffix "s" after the numeral indicates that the locomotive is equipped with superheater. Use of the suffix "s" was discontinued on locomotives designed after January 1st, 1923, although the superheater is employed.

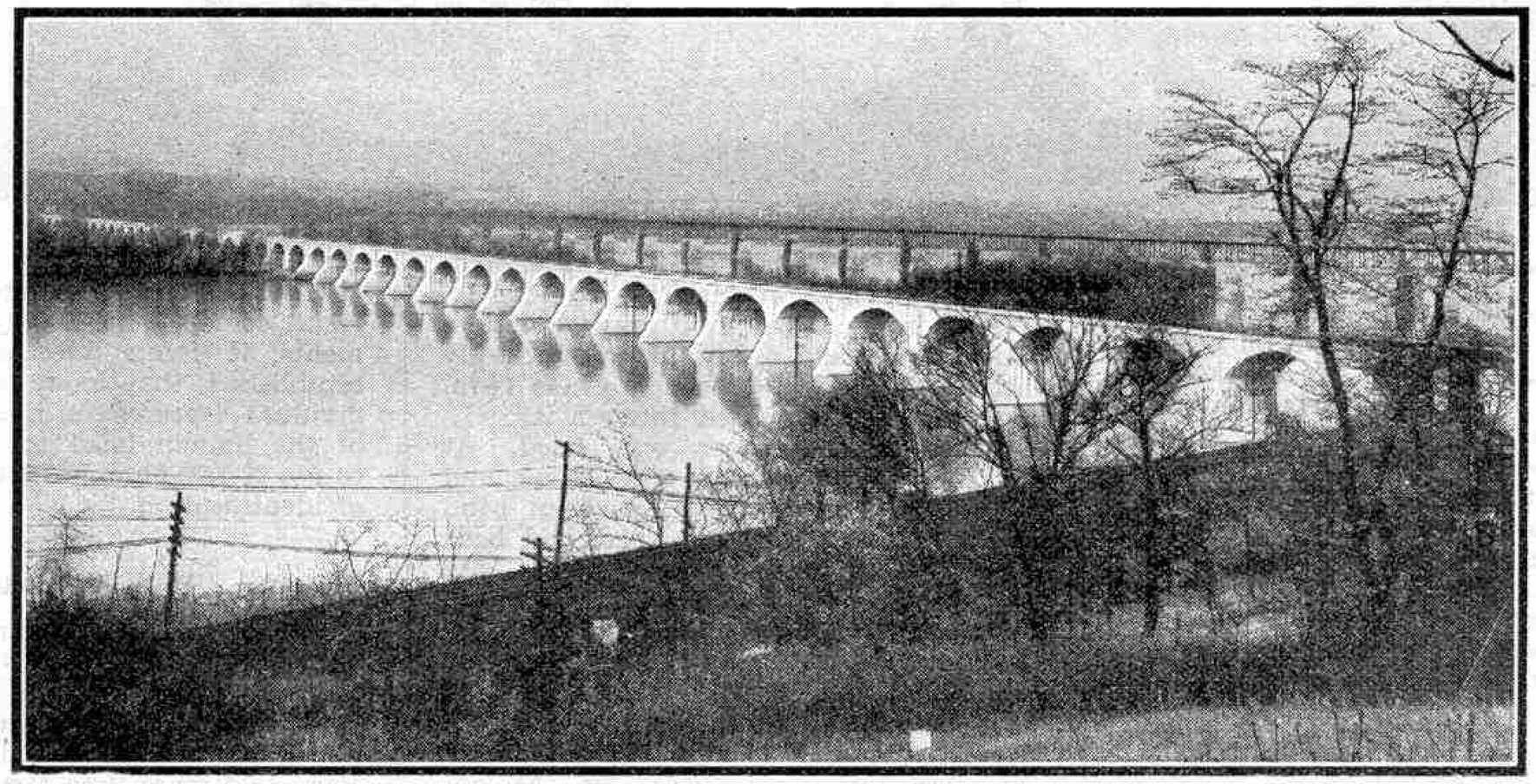
In the present classification of cars the different types are designated by primary letters, and the successive designs of a type by numerals (in the old classification by letters in alphabetical order) following the primary letters, modifications in a design being indicated by a small suffix letter. Passenger train cars equipped with electric motors are designated by the letter "M," placed before the primary letter or letters.

Along the main line route is to be seen some magnificent scenery and the accompanying photographs give some idea of the nature of the engineering work in connection with the railroad.

An outstanding constructional feature of the line is the concrete arch bridge over the Susquehanna River at Harrisburg. Through trains from the north and west to Washington and the south, as well as points in the Cumberland Valley, leave the main line of the Pennsylvania Railroad at Harrisburg and pass over this bridge to the west side of the Susquehanna River. The bridge is about 4,000 ft. in length and consists of 45 arch spans and one girder span over the low

grade freight line of the Pennsylvania Railroad. Twenty-three of the arches have a span of 77 ft. each, while the span of the remaining 22 is 74 ft. 6 in. All the arches have a uniform rise of 20 ft. with a crown thickness of 3 ft. The bridge carries two tracks laid upon a bed of stone ballast.

In constructing this bridge the stone piers of a former bridge were utilised. These carried a single-track steel deck truss bridge of 25 spans, averaging 170 ft. each. Intermediate piers were constructed and all the foundations were carried down to rock, which at this point is only a few feet below the bed of the river. The old tracks were located on the centre line of the present piers, and they were moved a distance of 7 ft. 6 in. to permit of the continuance of traffic while one half of the new bridge was constructed. After this was completed the tracks were again shifted and the other portion of the bridge was completed, so that the entire work was carried on without the slightest interference with traffic.



Courtesy] [*Pennsylvania Railroad*

Concrete Arch Bridge over the Susquehanna River, at Harrisburg

One of the most remarkable features of the Pennsylvania Railroad is the world-famous Horse Shoe Curve. This is situated just west of Altoona, Pennsylvania, and is a part of the ascent over the crest of the Alleghany Mountains. The strange shape of the curve is, of course, due to the necessity for making a track with a practicable gradient. It is what is commonly known as a nine degree curve, and extends over a distance embracing over 180 degrees. The westbound gradient rises 1.75 ft. in 100 ft. The crest of the curve west of Altoona is at Gallitzin, from which point there is a falling grade of practically one per cent. to Cresson.

The Horse Shoe Curve is on the main line of the Pennsylvania Railroad and it is by no means an uncommon occurrence for a 100-car freight train to be on it, when the unique spectacle is seen of cars attached to the same train actually moving in opposite directions!

Any description of the Pennsylvania Railroad system would be incomplete without reference to the terminal station in New York. This is reached from the mainland by tunnels under the Hudson River. The tracks in the station proper and in the underground yards and sidings cover a total area of 28 acres. Trains are worked out of the station electrically and the absence of smoke, together with the low line level, has made it possible to erect a huge skyscraper over the line. When complete, the station will be a veritable palace. It will include an hotel and office buildings together with an arcade of shops, public dining rooms and a hospital, in addition to the usual waiting rooms, booking-halls and circulation spaces. The only station at all comparable with it is that of the New York Central Railway in the same city. This also is at present incomplete and is being constructed on similar lines. When both are completed New York will possess the two largest and most magnificent stations in the world.

Famous Trains—(*continued from page 391*)

Field at 1.45 p.m. For a short distance we descend the deep valley of the Columbia River, bordered on the far side by the parallel range of the Selkirks. To cut off a 70-mile bend in the valley, however, the engineers carried the original line from Golden over the summit of the Rogers Pass, at an altitude of 4,343 ft. Not only were the grades to and from this summit very heavy, but constant trouble was experienced in winter and spring by reason of avalanches, which were so severe that 4½ miles of the line had to be protected by permanent snowsheds heavily constructed in timber.

After cutting out the "Big Hill" in the Rockies, therefore, the C.P.R. determined that they would also cut out the Rogers Pass completely by tunnelling for five miles under Mount Macdonald. The cost of this bore was six million dollars, and all mountain tunnelling records were broken by the completion of the tunnel in the short space of 3⅓ years. In this case the original route has been shortened by 4½ miles, and almost the whole of 13½ miles at 1 in 45 have been cut from the journey. In addition, a large force of pusher engines, snowploughs and other equipment has been removed from the Rogers Pass for more valuable employment elsewhere. Just after teatime on Thursday we reach Glacier, the station on the Pacific side of the Connaught Tunnel.

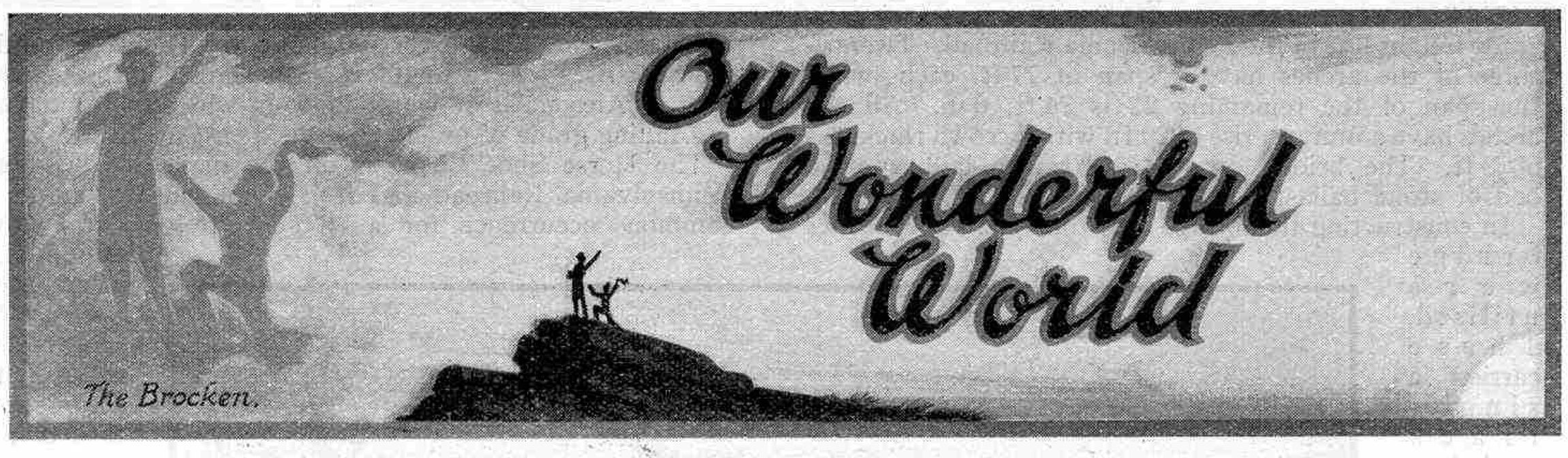
The rest of Thursday evening and Thursday night is spent in running through magnificent scenery, much of it unseen because of the darkness. At Revelstoke we rejoin the Columbia River Valley, having now reached a distance of 2,507 miles from Montreal. Continuing to descend, we are at Kamloops by midnight, where the rival Canadian National line, having come from northward through the Yellowhead Pass—the route originally planned for the C.P.R.—comes down the valley of the North Thompson River. After this we are to share the Fraser River Canyon together pretty well all the way to Vancouver.

Friday morning needs an early breakfast, for at last, having descended the "Pacific slope" to sea-level again, and having been in the train for four days and a half without a break, we roll into Vancouver, the western terminus of the Canadian Pacific Railway, at 9.0 a.m. We have travelled very little short of three thousand miles, and for once, if never before, we are glad to get out of the train!

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These Writing Pads are just the thing to use when writing to your friends, for the special notepaper shows at once that you are a Meccano boy.

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The Spectre of the Brocken

The picture at the head of this page depicts a scene that is visible on certain occasions on the Brocken, or Blocksberg, the highest summit in the Hartz Mountains in Central Germany. A traveller on the mountain at sunset on a day when cloudy mists are floating about the summit may be startled to see a giant walking along through space and keeping pace with his own footsteps. This is the famous spectre of the Brocken that has been the cause of much superstitious terror to the inhabitants of the surrounding country.

To-day it is easy to understand the origin of the spectre. It is merely a shadow cast by the rays of the Sun on the wall of mist, and it appears at sunset or sunrise because only then are the Sun's rays practically horizontal. Tradition fixes the summit of the Brocken as the scene of satanic revelry by night, and it was probably the sight of his own shadow that gave some belated traveller in less enlightened days the idea that the witches fly through the clouds to the summit to take part in the revels.

The Brocken was one of the last strongholds of heathen worship in Germany and the night of 1st May was supposed to be the occasion of the most important rites of the ancient worship. This, in conjunction with the shadow, no doubt accounts for the association that has always been supposed to exist between this particular mountain and the Devil. A railway now runs to the top of the Brocken and instead of witches the only visitors to the summit are the guardians of the meteorological station established on it, and tourists eager to see the sunrise.

* * * *

Foiling the Scientific Burglar

The increasing number of bank burglaries in America led recently to an intensive study of the resisting powers of various metals to the attack of the oxy-acetylene torch, the scientific burglar's most powerful weapon. Until last year expensive manganese and chromium steels were invariably used in the construction of safes and bank vaults, but some interesting experiments suggested that copper would be a much more suitable material, although it is much softer than the various alloys mentioned.

In a series of comparative trials it was found that an oxy-acetylene flame pierced a plate of steel 1 in. in thickness in a few seconds only, while cast-iron and an alloy of this metal containing a little copper did not offer a very much greater resistance to the flame. Even a circular safe door 16 in. in thickness proved unable to defy the heat of the torch for more than a few seconds. The door was compounded of a layer of steel 6 in. in thickness, an 8 in. layer of cast-iron alloyed with a little copper, and a 2 in. layer of five-ply chrome steel. In 24 seconds a hole 1½ in. in diameter was burned through it.

Lastly, pure copper was tried. At the end of 15 minutes the flame had penetrated to a depth of less than 1 in., and the tips of several burners had been melted off in the process. At this rate about two hours would be necessary to burn a hole in a copper plate 7 in. in thickness, far too great a time for the average burglar to spend in safety. A special copper alloy has since been developed that offers even greater resistance. The explanation advanced for the excellence of copper in this respect is that the metal is a better conductor of heat than are steel alloys, and distributes the heat throughout the whole mass, with the result that the temperature immediately surrounding the torch is not raised so high.

* * * *

Latest Uses for X-Rays

Pictures showing the course of the blood-vessels in the human body may now be obtained quite easily with the aid of X-rays. A few cubic centimetres of iodised oil are injected into an artery, whence they circulate throughout the body. X-ray photographs then show the track of the vessels as black lines, the rays being absorbed in passing through them because of the presence of the element iodine, and therefore making practically no impression on the photographic plate. The method is thus very similar to that in which barium or bismuth compounds are used to enable the passage of food through the alimentary canal to be followed.

A still more remarkable use was made of X-rays in identifying a skull found on the border of Tibet. It was supposed to be that of an American who went to India in 1925 with the intention of visiting the country of the Lamas. Entry was forbidden by the Indian Government, and while the traveller was waiting in camp on the banks of the Indus River in Kashmir for an opportunity to "disappear" officially, he disappeared altogether in earnest. Alarm was occasioned by this, and when search was made a body supposed to be his was found in the river 70 miles below the camp.

When the question of identification arose, two doctors who had carried out an operation on the dead man's head in 1920 supplied X-ray photographs taken at that time for comparison with new ones of the skull found in the river. The formation of the bone and the evidence of the operation performed five years earlier made identification quite certain. As a result of this experience and later experiments, it seems now to be pretty well established that there are sufficient individual features in the bone formation of the human head to make it possible to use X-ray photographs as a sure means of identification.

* * * *

Dyes in Foodstuffs

Many tons of dyes are used annually for colouring foodstuffs. Although the proportion of colouring matter added is always very small—sometimes as low as one part in half a million—two firms alone sold more than forty tons of colours for this purpose in a recent year, and there are many other firms that cater for the needs of the food trades in this respect.

Harmless vegetable extracts have been used for a considerable time, but there is now a tendency to replace them by coal-tar dyes. The dyes are not sold under their chemical name, but are as a rule made up in the form of a solution and given names that indicate their purpose. Thus one coal-tar dye known as chrysophenine is usually called egg yellow or butter yellow; bismarck brown is named chocolate; while tartrazine is the chemical name of a lemon yellow dye largely used in making egg powders. There is even a special dye known as apricot yellow that is used to improve the greenish shade of tinned apricots.

Dyes are added either to improve colour or to make synthetic products resemble natural foodstuffs. A classic example of the latter is margarine prepared from colourless oils, the dye being added to give the product the appearance associated with butter, as butter substitute that looked like lard would have no attraction. Such natural colouring matters as cochineal, caramel, and saffron have long been used to give an attractive appearance to confectionery, and the method has now been extended even to fish, special colours having been introduced to give a bright yellow appearance to smoked fillets. The colour is added to the brine in which the fish is cured. For kippers a special colour is prepared that confers on the fish a rich dark brown shade.

Many colouring matters that have been used in the past are now prohibited owing to the possibilities of harmful effects. Although the amount of dye absorbed by any one individual from a treated food is exceedingly small, there is a risk of slight poisoning from the use of some of them. The use of copper compounds for maintaining a green colour in preserved peas is one example.

Trout Emigrants to New Zealand

Trout from Loch Leven in Scotland were transported to the Antipodes about 60 years ago and their new home in the South Island of New Zealand proved to be so greatly to their liking that they and their descendants grew out of all recognition. The average New Zealand trout is six times the size of its Scottish cousin. Specimens weighing as much as 12 lbs. are frequent, and monsters as heavy as 30 lbs. in weight have been caught.

The great increase in size that has resulted from the transportation to the southern hemisphere has prompted another interesting experiment. Some of the New Zealand trout are being introduced to Scottish waters. Thousands of eggs were brought to Scotland on trays on which ice water dripped continuously during the voyage, and have now been put into the rivers near Stirling. It will be very interesting to see if these giant trout maintain their size in the home of their ancestors.

Several other very interesting efforts have been made to acclimatise fish in strange waters. Into South African rivers, for instance, Scottish trout and other British fresh-water fish have been introduced recently with excellent results, while halibut and herring are to be transported through the tropics to the cool waters of the south Atlantic Ocean off the coast of Cape Colony. Perch, tench, carp and minnows have been liberated in large numbers in the streams of the Murray River country in Australia, while the latest suggested transfer is black bass from North America to South Africa. This fish grows fast, reaching a weight of about 4 lb. at the end of five years. It is delicious to eat, and if the effort to establish it is successful it will be a great acquisition to the fishermen in its new surroundings, as it is a fine sporting fish. The eel is another fish that makes interesting voyages, five million being taken to Germany from the Severn last year.

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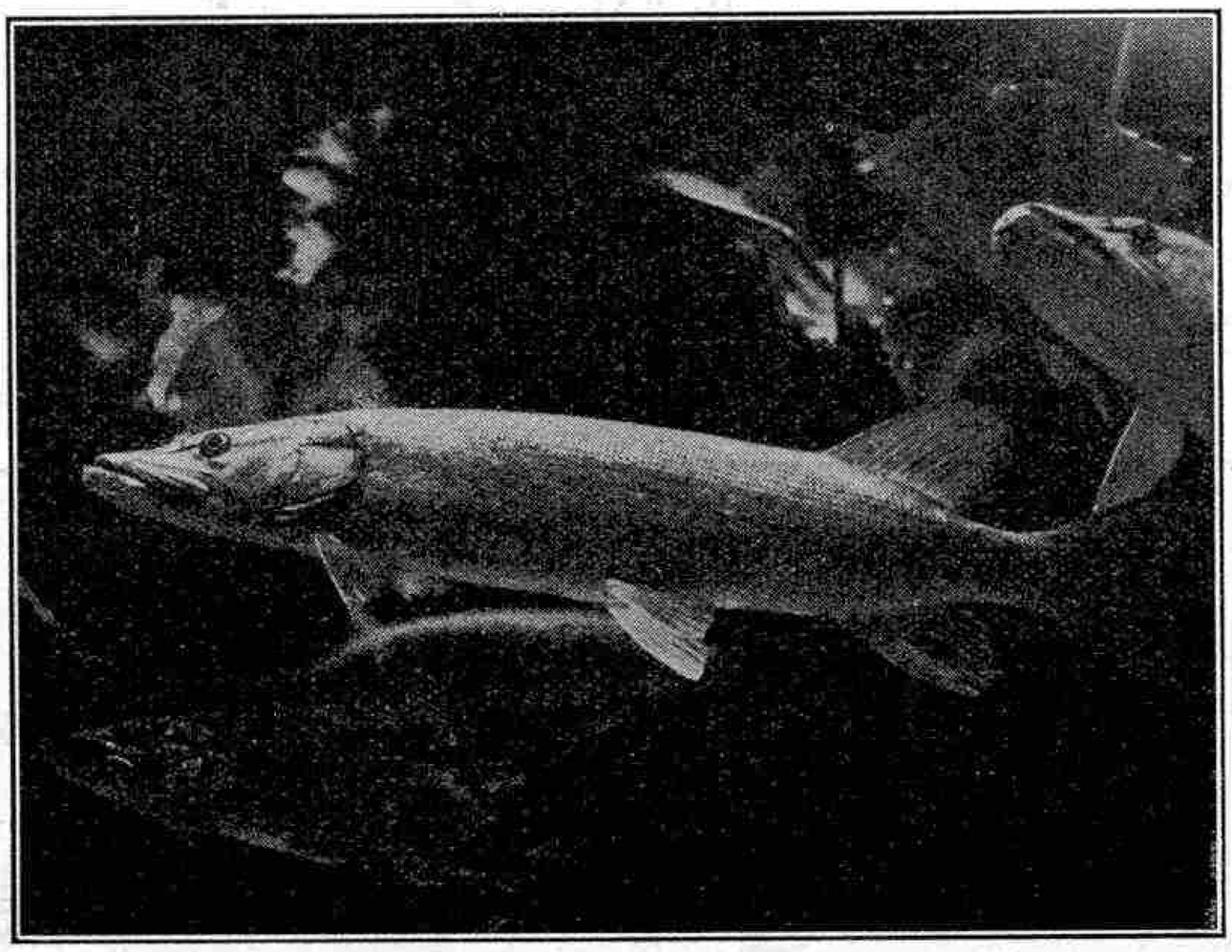
Why Clothes were Invented

The common idea regarding the origin of clothes is that they were introduced to protect the wearer from the elements, and it has also been supposed that the desire for personal adornment had something to do with it. A novel suggestion with more than a germ of truth in it has been made by an American professor of psychology. This is that clothes were invented to keep off flies and mosquitoes.

Primitive man certainly had close associations with many crawling and flying pests, and even in cold countries such as Greenland there are times when mosquitoes bite unmercifully. The author of the theory points out that the most efficient protection is given by hanging strips and leaves that flap about in much the same manner as an animal's tail when it is being used to remove flies, and that the earliest clothing seems to have been of this type.

A Month with 10 Sundays

Readers of Mr. Hornby's account of his tour round the world will remember his remarks on the international date line that runs from north to south across the Pacific Ocean. When this line is crossed in a westerly direction a day is missed out, while on making the crossing in the opposite direction the day becomes the day before!



A fine photograph of a Pike taken by Mr. Neville Kingston at the Zoo Aquarium, London

The line passes through the Bering Straits between Siberia and Alaska and very curious things may happen on ships that often cross it. Imagine a ship sailing from a Siberian port on February 1st in a leap year in which this date falls on Sunday, and making weekly sailings between the port and Nome, in Alaska. When the ship reaches the date line the day becomes Saturday, and consequently the following day, spent on the eastern side of the line, is also Sunday. Thus the crew of the ship will experience two Sundays on successive days, and if the line is crossed a few minutes before midnight, both will practically be complete Sundays. A day or two later they make the return journey and set off eastward from the Siberian port once more on the following Sunday. The same process is repeated, two successive Sundays being experienced. As there are five Sundays in February under the conditions noted above, this means that for the crew this particular February will have 10 Sundays!

* * * *

World's Largest Concrete Block

The largest slab of concrete in the world is 110 ft. in length, 78 ft. in width and more than 3 ft. in thickness. It was made in America and is the roof of a masonic temple recently erected at Alexandria in Virginia. To make the roof of a building of a single slab of material was quite a bright idea, and its accomplishment was only possible with the aid of concrete, 953 cubic yards of which were delivered down a movable chute into a framework resting on massive beams and columns that were made of reinforced concrete.

Treasures in Sea Water

The oceans are great accumulators of Earth's mineral treasures and among other substances have collected gold in large quantities. Unfortunately the proportion of gold to water is so small that any method of extraction would be far too costly. The largest proportion of gold is found in the water near Newfoundland, but even there the amount is only 1/10th of a grain in a ton of water.

Other substances present in far greater quantity, and which were formerly extracted, are now obtained more cheaply from other sources. The mineral substance present in greatest amount is, of course, salt, the chief agent in giving seawater its characteristic taste. In extracting it the necessary process of getting rid of the superfluous water is fairly costly, but in hot countries the natural heat of the Sun has long been used for partial evaporation. The method adopted is to allow the tide to fill shallow tanks in which the water has a large surface in comparison with its bulk. Evaporation then takes place, with the result that the proportion of salt is increased until it crystallises out or is present in sufficient proportion to make evaporation by heat a paying process.

Another method of extracting salt that has been used is to allow the seawater to trickle down stacks of brushwood exposed to the wind, final evaporation being carried on in heated pans. Pure salt from mines in Cheshire and elsewhere is now obtained so cheaply and easily, however, that methods of extraction from seawater are of comparatively little importance.

One other substance that has been extracted from seawater on a commercial scale by a very interesting method is iodine. This is present in very small proportion and cannot be extracted directly, but advantage was formerly taken of a curious natural method of extraction. Certain seaweeds absorb iodine compounds from the sea, and thus effect a preliminary concentration. They form a large proportion of the kelp or seaweed cast up by Atlantic storms on the west coasts of Ireland and Scotland. The kelp was burned and the ash treated for the recovery of the iodine contained in it. This method is now of no practical importance, as the sodium nitrate found in Chili contains more than sufficient iodine to satisfy the world's requirements.

* * * *

How Red Indians Live To-day

The change brought about in the mode of life of the North American Indian by the coming of the white man is well illustrated by the fact that in 1927 Indians who had taken up farming in Canada raised in round numbers one million bushels of grain. The Red Indian population of the Dominion totals 105,000, and of these 35,000 dwell in the Prairie Provinces. The land seeded by them last year amounted to 64,534 acres, an increase of 2,385 acres over 1926.

AVIATION AS A CAREER: II.

The Value of "Stunt" Flying

Training Pilots to Meet Emergencies

By "Airman"

CONTRARY to the ideas of many people, the "fancy" flying that is indulged in by airmen is not due merely to an exuberance of spirits, nor to a desire to "show off." No doubt there are young pilots who work off their surplus energy in this fashion, but behind all their "stunting" there is a more serious purpose. It is excellent training for war aviators, scouts and fighters, for very often the success of a pilot in an engagement depends upon the manœuvrability of his aeroplane and his skill in manipulating his machine so as to secure the best advantage over his opponent.

How is such "stunt" flying performed? It is difficult to explain briefly how the various evolutions are carried out unless the reader has some knowledge of the controls of an aeroplane and their action. It will be well, therefore, to explain how an aeroplane is controlled before proceeding to a description of the methods employed in advanced and "stunt" flying.

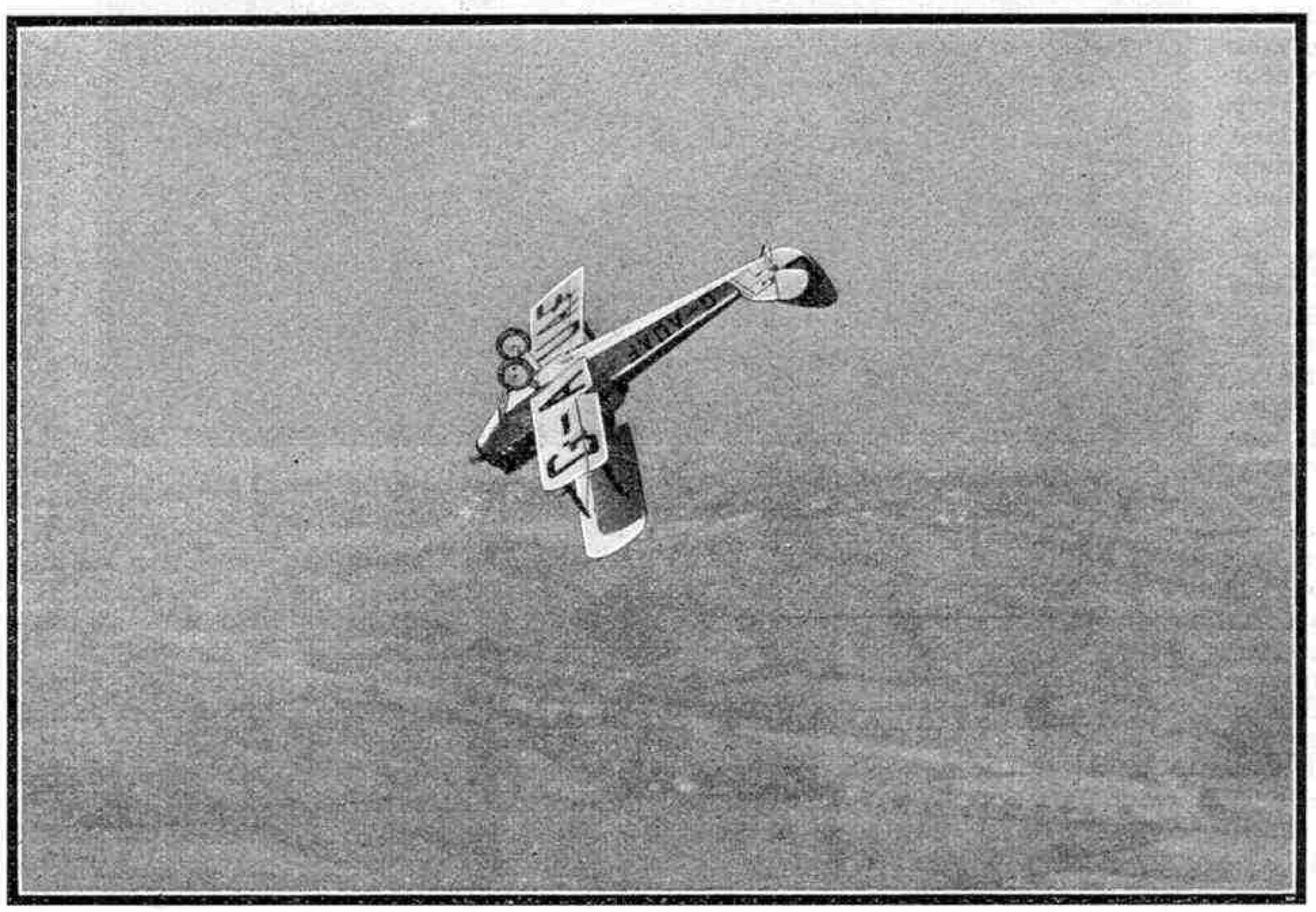
From the bottom of the fuselage in the pilot's seat there projects a vertical bar, called the control column, or "joystick." This is pivoted about three-quarters of the way down and can be moved backward and forward and from side to side from the pivoting point. The stick controls the elevator and ailerons. The elevator is a horizontal controlling flap set parallel to the main planes at the rear of the machine and hinged so that it can be moved upward and downward. It is connected to the control column by wires so that, when the stick is pushed forward, the elevator moves downward from its hinge, thus presenting more resistance to the air when the aeroplane is in flight and sending the nose of the machine downward. When the stick is pulled back the elevator flap is raised and the nose of the machine goes up.

The control column is also connected to the aileron flaps on each of the four wings. These flaps move upward or downward according to the movements of the control column. When the stick is moved to the left, the ailerons on the right side are pulled down, setting up an additional resistance on that side and causing that wing to rise. At the same time the ailerons on the left side are slightly pulled up, assisting the downward motion of the left wing. The movement of the ailerons is slight, but sufficient to cause the machine to bank.

When the lever is pushed to the right, on the other hand, the left ailerons are depressed, and those on the right slightly raised, so that the machine banks to the right.

The rudder is controlled by wires connected to the rudder bar, which is a piece of wood or metal pivoted about its centre and arranged athwartships, so that the pilot can swing it about its centre with his feet. The rudder is parallel to the fore-and-aft line of the machine when the rudder bar is square, and the machine will then fly straight, but if one side is pushed forward the rudder is swung in the same direction. For example, if the left foot is pushed forward the rudder swings to the left, more resistance to the wind being thus given on that side, so that the tail of the machine is forced to the opposite direction and the nose of the machine turns to the left. To turn the machine to any side, therefore, the foot on that side is pushed forward on the rudder.

In order to make a turn, however, it is not sufficient to move the rudder bar in the required direction. If the rudder only is used the machine skids, or slips outward, an effect due to the difference in speed between the inner and outer wing tips. The aeroplane must be banked so that it will not lose speed and slip outward. Thus, to make a left-hand turn the left foot is pushed forward on the rudder and at the same time the control lever is moved to the left. When the machine is to be flown level again, the control lever is pushed across again and a little past the central position, and the right foot is pressed on the rudder. The controls are then centred so that the machine flies straight and level.



Courtesy [*De Havilland Aircraft Co. Ltd.*

A striking photograph showing the manœuvrability of the De Havilland Moth. It was taken just as the machine was on its back in a roll. The ailerons (control flaps on the main planes) can be seen hard over

These, in brief, are the actions of the controls, but before proceeding with a description of more advanced flying, embracing steeper turns and glides, and so on, it is essential for the reader to give some consideration to the problem of what is known as the inversion of controls.

Suppose the machine is executing a vertical turn, that is a turn in which the aeroplane is on its side relative to the horizon. If the machine is given left rudder—which means that the left foot is pushed forward—when the aeroplane is on the turn, which we are assuming to be a left-hand one, the nose will turn toward the left wing, as it would if the machine were flying level, but, *relative to the horizon*, the nose will go down. If right rudder is given, the nose will go up.

Now consider the action of the elevator. If the control lever is pulled back, the nose will tend to approach the tail, as happens when the machine is flying level. But, as the machine is on its side, the action of the elevator is simply that of forcing the machine to turn, as it now occupies the position of the rudder, relative to the horizon.

Thus, on a vertical bank, the actions of the rudder and elevator are reversed—that is, the nose of the aeroplane is made to fall below or rise above the horizon by means of the *rudder*, and the aeroplane is made to turn by means of the *elevator*. In turns of 45 degrees the elevator acts, so to speak, half as rudder, and the rudder half as elevator. In steeper turns the actions of the rudder and elevator become more and more reversed.

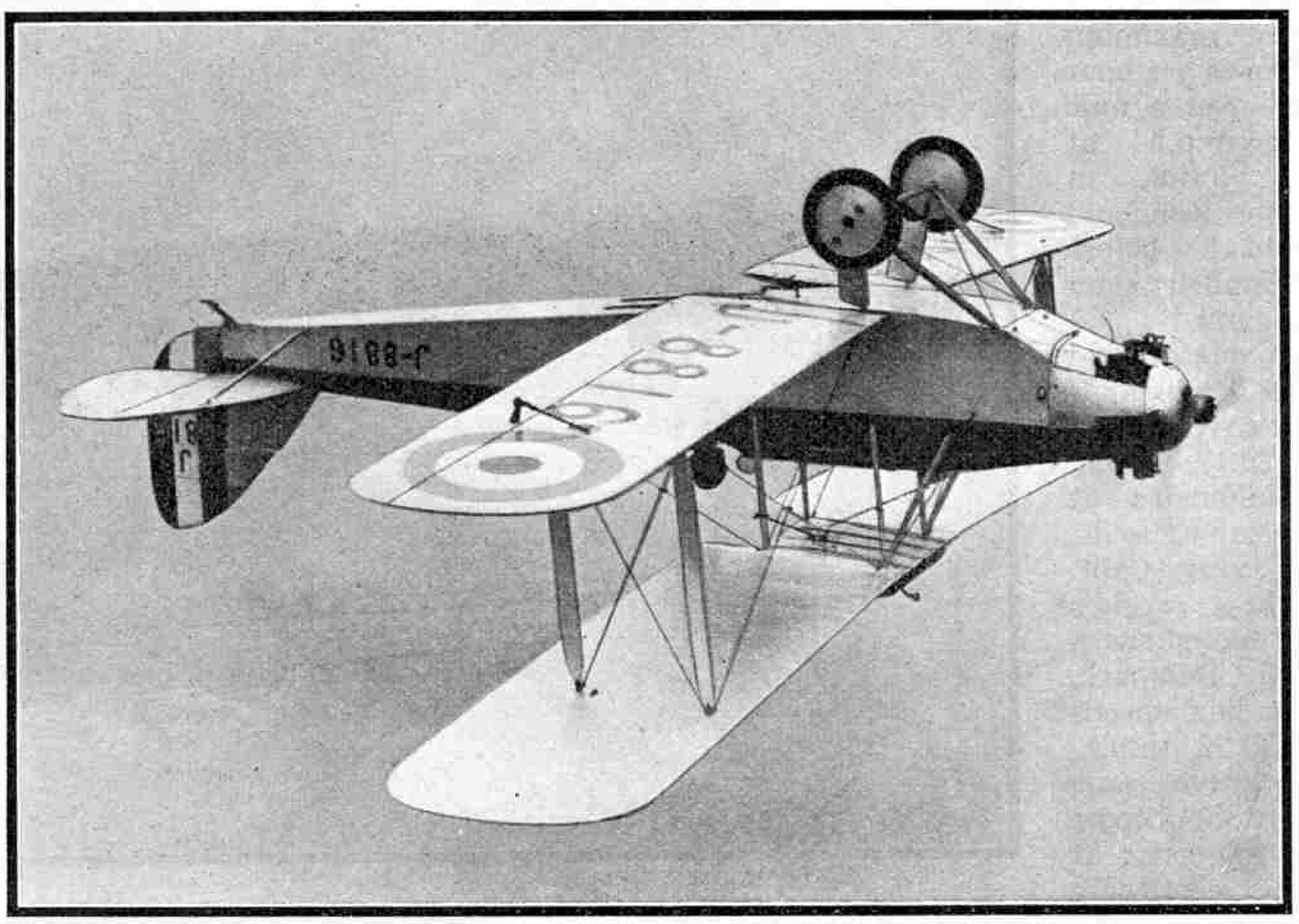
The reader will now understand the actions that take place when

a steep turn is made. If, for example, it is desired to make a steep turn to the right, bank and rudder are applied in this direction until the machine is on its side. Then the rudder is used to trim the nose of the machine to the horizon. Right rudder depresses the nose and left rudder raises it.

The speed of the machine increases when the stick is pulled back and, as the aileron on the left wing is down, a lift is imparted to that wing and the bank tends to become steeper. Thus the stick must be moved to the left to ease off the bank, as well as backward to turn the machine and speed it up.

To get out of the turn the lever is moved to the left, left rudder is given when the machine is approaching the level position, and the control column is then centred again.

A vertical bank is a term applied generally to all banks of over 45 degrees. This has already been described and, as has been said, the position of the nose relative to the horizon is governed by the use of the rudder. In turning in this fashion the control column and rudder are pushed over in the desired direction, the nose is trimmed to the horizon, the control column is then eased slightly backward and in the opposite direction. Coming out of the turn, full opposite bank is given, and then opposite rudder when the machine is nearly level. Then the stick is put forward.



Courtesy] **Inverted Flying on a Genet Moth** [*De Havilland Aircraft Co. Ltd.*

From a vertical bank the pilot can proceed to a spiral, which is merely a circular vertical bank made with the engine cut off. If he should find himself descending too rapidly in a spiral descent he pulls the stick back slightly. The inversion of controls phenomenon takes place if his angle is too steep.

A popular "stunt" is the nose dive. This is performed by putting the stick forward and, preferably, cutting off the engine to lessen the strain on the aeroplane. This evolution is never performed near the ground, except in cases of attempted suicide! One thousand feet is the height at which the pilot should come out of the dive. He pulls his stick back firmly. If he should pull the control lever back too rapidly the machine may jump suddenly in the air. When performed intentionally this trick is called a "zoom," the machine climbing steeply and suddenly by virtue of the surplus speed it has attained. When stalling speed has practically been reached the lever is put forward again.

A word as to "stalling." When an aeroplane climbs, the resistance of the wings to the air is greater than when the machine is level. An aeroplane flies by virtue of this resistance, and if the speed is not great enough to maintain it the machine will dive until the conditions are again satisfactory for flight. Before the moment of stalling the pilot will notice that his controls have become "sloppy," owing to the fact that insufficient air is passing the controlling surfaces, and the pilot must then beware. He must increase his speed, and when at a fair height this increase is safely obtained by diving the machine. Stalling is a useful movement when performed intentionally in the course of stunting, but an unfortunate one if it means simply that the pilot has lost control of his machine.

"Looping the loop" is a manœuvre that never fails to interest even those least conversant with aeronautical matters. There is a common idea that the pilot must be strapped in his seat when looping or otherwise he will fall out at the top of the loop, but as a matter of fact there is no fear of this when a loop is correctly performed, owing to the effect of centrifugal force.

A loop is performed by putting the nose down at a height of about 4,000 ft. and attaining a speed of about 80 miles per hour or over. The angle, of course, is not so steep as that used in a nose dive. Then the stick is pulled back firmly, and the machine soars upward and over. The stick is pulled right back and more quickly in the later stages of the pull, and held back as far as it will go until the loop is completed. When the top of the loop is reached the engine is cut off, and when the top of the loop is passed the stick is eased forward and gradually centred. Then the machine is pulled out of its dive earthward and the engine is switched on again.

There are right and wrong ways of looping, as many a pilot has found out to his cost. Different machines behave differently, and perhaps it is needless to state that the machine itself should be correctly trued up and in the best working order. The preliminary dive should not be too steep, as there will otherwise be a great strain on the machine. This is a favourite "stunt," but not so simple as it sounds, for the pilot may find himself in a queer position when he comes out of the loop unless he knows his machine well.

Sometimes pilots stall their machines intentionally, the nose dropping when the stick is pulled back and the engine cut off. The effect is that the machine loses flying speed, as has been explained, and slides back on its tail or falls over on one wing. Then the engine is restarted or the nose put down, so that the pilot regains control. The "tail slide" is a favourite trick of airmen.

If the pilot rudders strongly when the engine is cut off after a stall with the stick fully back, he achieves a spinning nose dive. If the controls are centred the machine will begin to nose dive, and the pilot then restarts his engine.

A roll consists in making the aeroplane loop sideways and fly on in the same direction as before. It is performed by pulling the stick back after getting up speed and ruddering fully in the desired direction. Another type of roll—a delightful manœuvre for those not prone to air-sickness in any shape or form—occurs when the stick is moved round in a circle and the rudder moved correspondingly—for example, to the right when the stick comes round to that direction.

In the cartwheel the machine is speeded up, the stick is pushed forward, and then pulled back again. The machine soars up, and rudder and bank in the same direction are applied. When the aeroplane is almost vertical on its tail is the moment to apply this rudder and bank, and the machine will then cartwheel and come out in the opposite direction. As the machine turns the engine is cut out and the machine dives. Readers will recognise the essentials of the well-known Immelmann turns in this manœuvre.

Falling-leaf and boot-lacing stunts are modifications of the stalled turns manœuvres, with the machine pulled first to one side and then to the other.

These evolutions would perhaps seem senseless and needlessly dangerous to those not possessed of the love of flying. Their value in warfare cannot be exaggerated, however, and many a pilot has thanked his stars that he has neglected no opportunity to practise them. The risk is negligible when a sufficient height is gained. Strange as it may appear to some, pilots do not believe in taking risks, if by risks we mean unnecessary ones such as stunting at low altitudes. The best pilot is always the one who sets a high value on his own life and is not willing to risk it in failing to allow for emergencies, but there is no doubt whatever that by far the best way to learn how to get out of unpremeditated "stunt" positions is to practise getting out of premeditated ones.

Over 214 Miles Per Hour! The Gre

Captain Malcolm Campbell's Wonderful Ach



WHEN Major H. O. D. Segrave startled us by achieving a maximum speed of over 207 miles per hour and a mean speed over a mile of nearly 203.8 m.p.h. at Daytona Beach, Florida, in March last year, one wondered how long it would be before Capt. Malcolm Campbell again took a hand in the game!

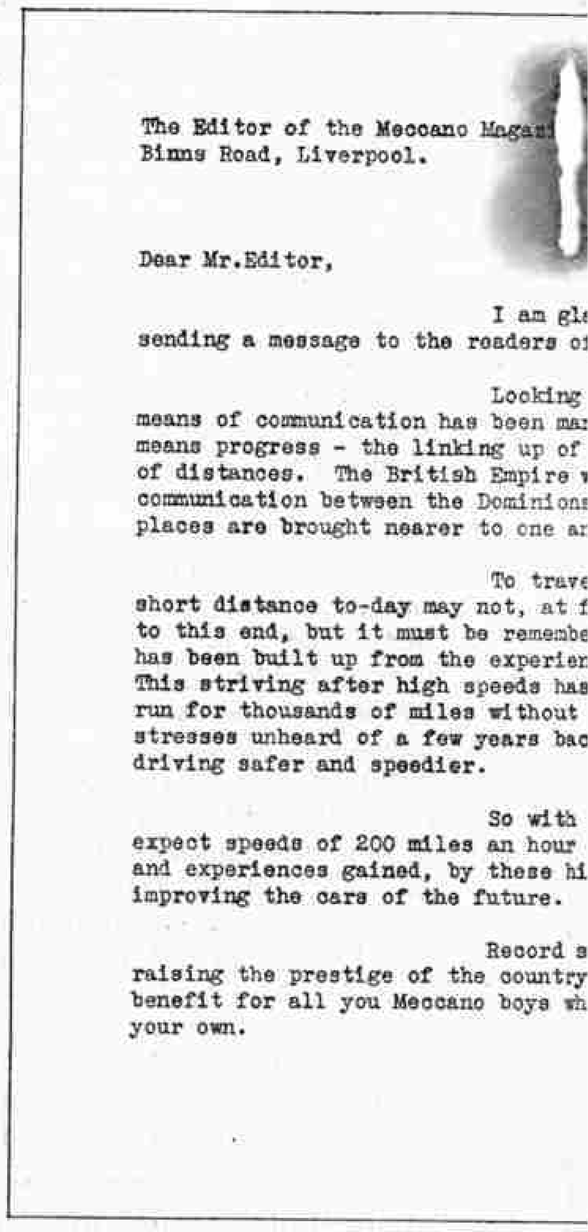
These famous drivers are old rivals. In 1922 at Brooklands K. Lee Guinness covered the flying mile at 129.17 m.p.h. and the flying kilometre at 133.75 m.p.h., mean speeds. In the following year Capt. Campbell beat these world's records—curiously enough with the same car—in Denmark, achieving corresponding speeds of 137.72 and 136.32 m.p.h. In 1926 Major Segrave came on the scene and at Southport covered the flying kilometre at 150.869 m.p.h. This record was lowered shortly afterwards by the late J. G. Parry Thomas at Pendine, his mean speeds being 171.4 m.p.h. for the flying mile and 172 m.p.h. for the flying kilometre. It was not long before Capt. Campbell came into the limelight once more and set up fresh records of 174.224 m.p.h. for the mile and 174.883 m.p.h. for the kilometre. Major Segrave's great achievement at Daytona followed, and in February last Capt. Campbell provided yet another demonstration of the fact that records are made only to be broken.

Capt. Campbell's new records were achieved under conditions that were far from ideal, as a very strong wind was blowing at the time. Travelling with the wind his speed for the mile was 214.797 m.p.h., while against the wind his speed fell to 199.667 m.p.h. The mean speed therefore was 206.356 m.p.h.—almost 3 m.p.h. better than Major Segrave's figures. Capt. Campbell's wonderful driving was shown during this run when he succeeded in bringing his car under control after an exceedingly bad skid.

"*Bluebird,*" the Napier-Campbell car in which Capt. Campbell achieved this fine performance, was specially designed for high speeds and therefore has the least possible projecting surface. It was built by Barkers Limited, the well-known coach-builders, and embodies the results of a series of elaborate tests on models carried out by Mr. R. A. Pierson, chief aeroplane designer to Messrs. Vickers, in their wind tunnel. The design follows aeroplane practice very closely, the arrangement of the driver's seat resembling that of the cockpit control adopted for fast aeroplanes. A unique feature is detachable wings fitted at the tail of the car to give greater directional stability, and prevent "yawing" at high speeds. The body is built of 18-gauge aluminium.

The chassis frame has been built at Messrs. Vickers River Don Works. Tubular cross members are used throughout, the majority of which are made of solid forgings, the material used being Messrs. Vickers special steel. The frame is underslung under the rear axle to provide a very low layout, in order to assist in guarding against overturning when travelling at high speed.

To most readers the engine will be the most interesting feature of Capt. Campbell's car. This is a special racing Napier aero engine, for the fitting of which special permission was granted by the Air Ministry. It is a development of the standard Napier "Lion" engine, but whereas the latter develops only 450 h.p., the racing engine at 3,300 revs. per minute gives the remarkable figure of 875 h.p. The weight of the engine is 835 lb. and it has a compression ratio of 10 to 1. This ratio is very high indeed and is only made possible by the use of Ethyl.



The Editor of the Meccano Magazi
Binns Road, Liverpool.

Dear Mr.Editor,

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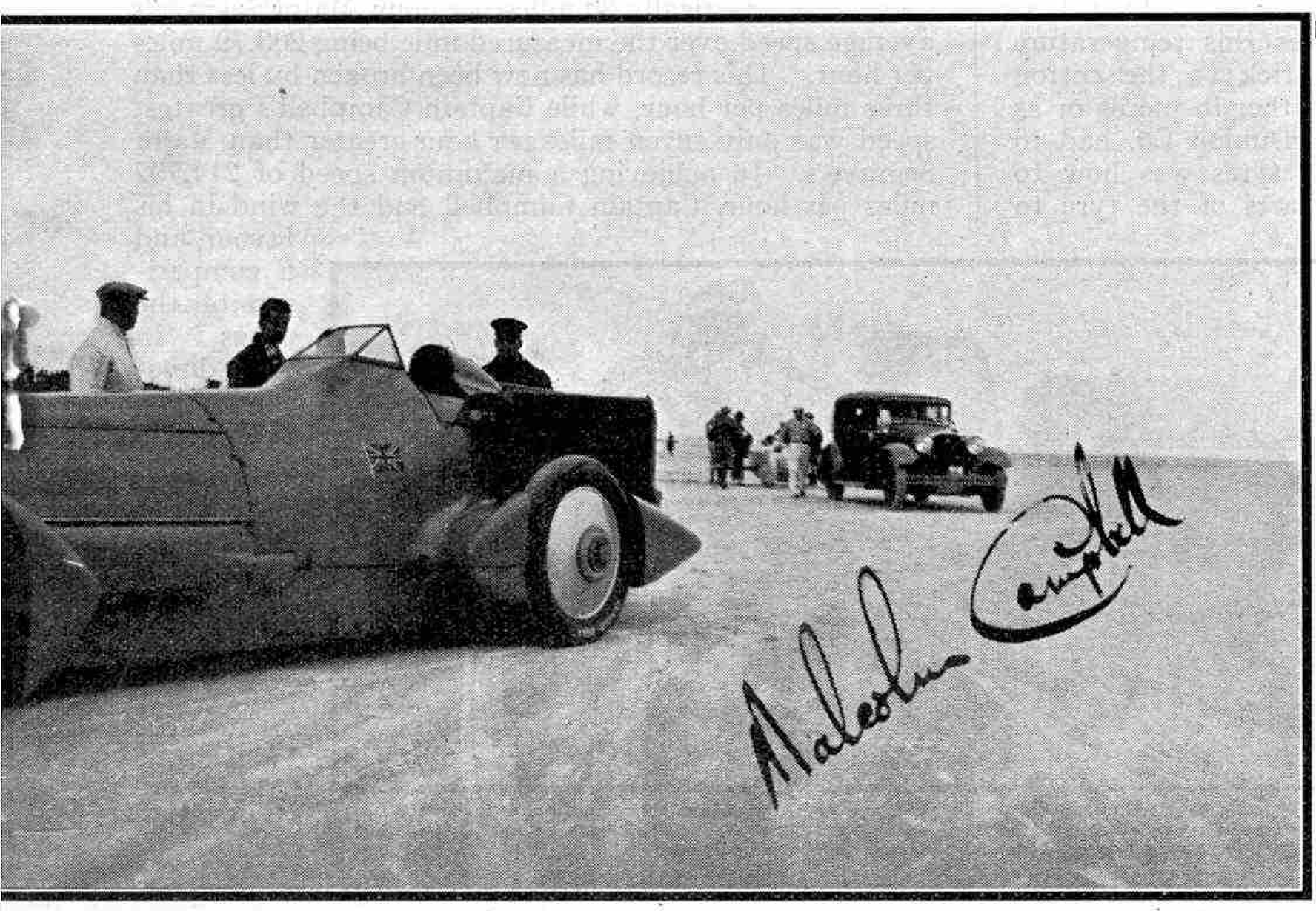
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hievement on "*Bluebird*" at Daytona Beach



Interesting details have been given regarding the oil and petrol consumption. The latter is used at the rate of 50 gallons per hour, while a gallon of oil only lasts for 20 minutes.



London
21st April 1928.

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Malcolm Campbell

It will be seen that the engine of the "*Bluebird*" develops as much power as one of the most powerful locomotives. It represents the most modern development in the design of internal combustion engines and its compactness and the low weight per horse power developed form a remarkable tribute to British engineering skill.

The drive is carried to the gearbox through a clutch of the dry multiplate type that has 16 surfaces specially Ferodo lined, the plates having a mean diameter of $11\frac{1}{4}$ in. and an extra large metallic flexible joint $13\frac{1}{2}$ in. in diameter.

The gearbox is remarkable, as it is of the epicyclic type, made under the joint patents of Mr. W. S. Forster Brown and Mr. Joseph Maina. It provides three speeds and reverse; the ratio between the primary and secondary shaft being 1 : 0.333 for first speed, 1 : 0.666 for second, and 1 : 1 for top gear.

The main feature of this gear is the elimination of frictional braking surfaces for the purpose of obtaining turning power or torque. The satellite carriers are positively brought to rest by the patent device, by means of which the power is transmitted without the least friction. The efficiency of this gear is such that by a slight pressure of the thumb on the satellite wheel of the second speed element, when in gear against the resistance of the primary shaft coupled to the engine, the car can be made to crawl, which shows how completely friction has been eliminated, both in the bearings and in the mesh of the gears, through the whole of the transmission.

For lubrication oil from the sump is conveyed under pressure in the main shaft and distributed to every gear and to every bearing by centrifugal action. The gear case forms an integral unit with the torque tube and rear axle frame, the whole of the transmission from the spherical joint in front of the gear to the rear wheel being thus in one unit.

The rear axle is designed with an arrangement whereby the final drive is independent of any deformation that might occur in the aluminium casing. The final drive, which for the higher speed has a ratio of 1.5 : 1, is of the Reinecker bevel gear type. Full floating axle shafts are provided, and the driving ends on the hub side are formed solid with the axle. On both sides of the central aluminium casing two conical arms, machined from forgings, the beam of the axle, and at the end are supporting the hubs of the wheels.

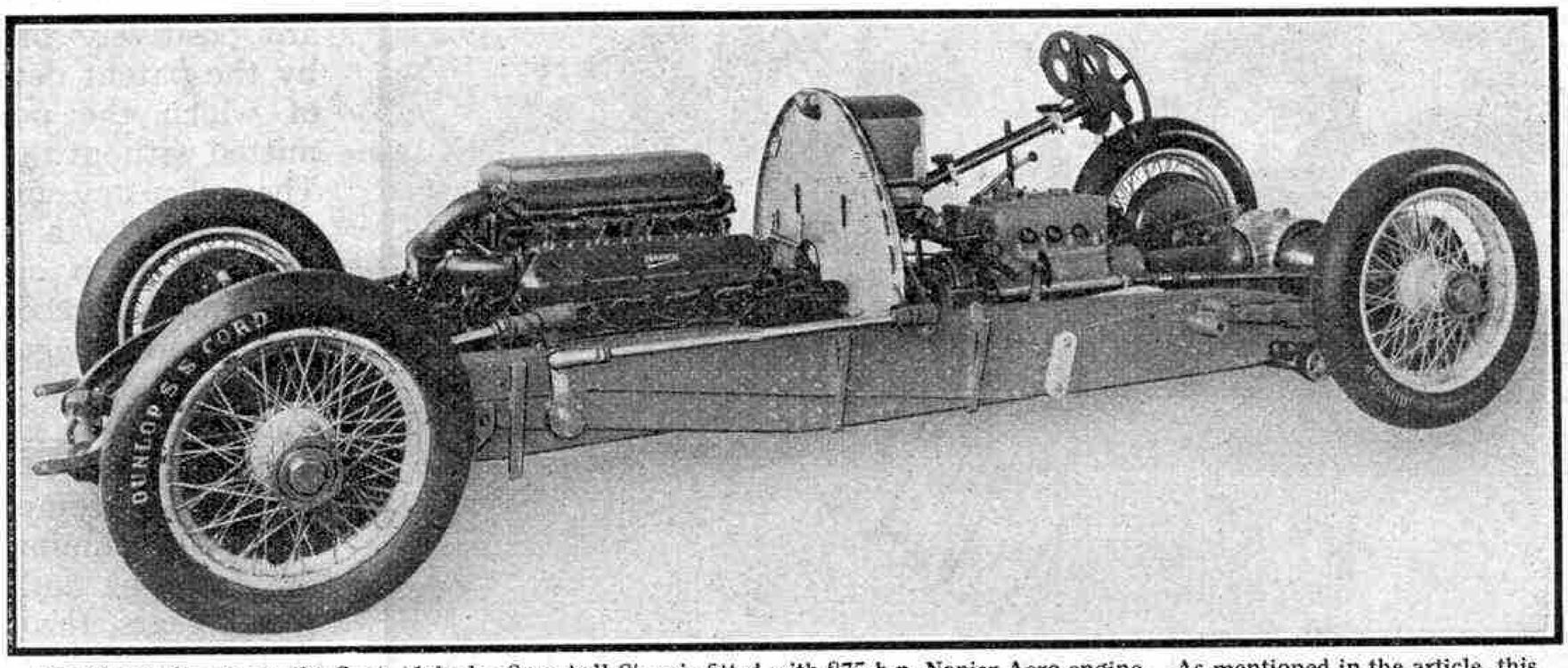
As with other parts of the car, very careful tests were made by Messrs. Rudge-Whitworth to discover whether any strengthening of the standard wheel was necessary. The wheels were subjected to heavy impacts and great torsional stresses and were shown to remain undamaged at loads far in excess of the calculated loads which will be met in actual running, and it was therefore decided to fit the standard Rudge-Whitworth Wheel which is supplied on many of the principal British and Continental cars.

The complete wheels have been subjected to a series of balancing tests. The wheels were balanced individually, whilst running, through an artificially created period, by means of a special dynamic balancing machine which indicated the position where balancing weight is required and the amount of the compensating weight required to ensure vibrationless running at the

high speeds that Capt. Campbell hoped to attain.

The tyres have also been specially made by The Dunlop Company after a series of special tests. An enormous amount of heat is generated in the tyres of a racing car owing to the enormous number of impacts with the road. At a speed of 220 miles per hour, for instance, every portion of a tyre is compressed and released 34 times a second. Rubber is destroyed at 200°C. If a racing tyre approaches this temperature the rubber tread can no longer stick to the cotton foundation and tends to strip off, either in pieces or as a whole. The problem which the Dunlop Co. had to solve in the construction of these tyres was how to treat the rubber and component parts of the tyre to enable it to withstand this repeated hammering and resistance to centrifugal force.

Each front wheel is directly controlled by the steering gear, while the track rod is retained. Two Marles steering gears are used for this purpose, but although the lock of each wheel is directly controlled, the Ackermann action is maintained by the layout.



Our illustration shows the Capt. Malcolm Campbell Chassis fitted with 875 h.p. Napier Aero engine. As mentioned in the article, this car is the holder of the world's record for the fastest speed on land, 206.95 miles per hour. It is the same engine that was fitted to the Supermarine Napier Seaplane that gained the Schneider Trophy

Four wheel brakes are provided, controlled by foot pedal and lever alternately, with an auxiliary control by vacuum servo of the Clayton Dewandre type. The brakes on the four wheels are all of the same size. The brake drums are made from solid forgings of special high carbon steel, and have an internal braking surface of 18 in. diameter by $1\frac{5}{8}$ in. width. Thin fins for cooling purposes are machined on the outside. The shoes, made in "Wilmil" alloy with a lining specially made by Ferodo Ltd., are also identical and are operated by cams of the logarithmic type.

Quick-acting and reliable instruments are essential on a car designed to travel at a speed of more than 200 miles per hour, and in order to provide for emergencies all the instruments used by Capt. Campbell were duplicated. They included revolution counters, speedometers and pressure gauges, the latter indicating oil pressure in the lubrication systems of engine and gearbox. Thermometer gauges were also fitted in order to keep the driver informed of the temperatures of the cooling water and oil. An interesting feature of the cooling arrangements is that no radiator of the ordinary type was fitted. Instead surface radiators were used, these being fitted between the wheels and the body on either side.

It is interesting to note how the speed record has increased during the last six years. The record of 129.17 miles per hour set up by K. Lee Guinness in 1922 was raised in the following year to 137.72 miles per hour, and subsequently to 174.224 miles per hour by Captain Campbell with his former "*Blue Bird*," which had a Napier engine developing 450 h.p.

An extraordinary effort was then made by Major Segrave. He used enormously increased engine power, his two engines developing over 1,000 h.p. against the 450 h.p. of Campbell's engine, and in general layout his car differed considerably from any previously constructed. The result of the introduction of new ideas was seen in an increase of practically 30 miles per hour, Major Segrave's average speed over the measured mile being 203.79 miles per hour. This record has now been broken by less than three miles per hour, while Captain Campbell's greatest speed was only seven miles per hour greater than Major Segrave's. In achieving a maximum speed of 214.797 miles per hour, Captain Campbell had the wind in his favour, and a comparison of the times in both directions of the two cars seems to indicate that he received more assistance from it than did Major Segrave. It almost seems, therefore, that the limit of speed under present conditions has nearly been reached, and that further efforts will only succeed in raising the figure by a few miles per hour unless entirely new methods are introduced.

Judging by the reports available, a new method that may result in an enormous increase has already been found in Germany. One of the best-known automobile firms in that country has built a car that is propelled by the discharge of rockets from steel pipes fixed to the rear. The passage of the monster is accompanied by a terrific roar, and it leaves a trail of flame and dense smoke behind it. It is said that by this novel method a speed of 430 miles per hour was attained for a few seconds in recent trials.

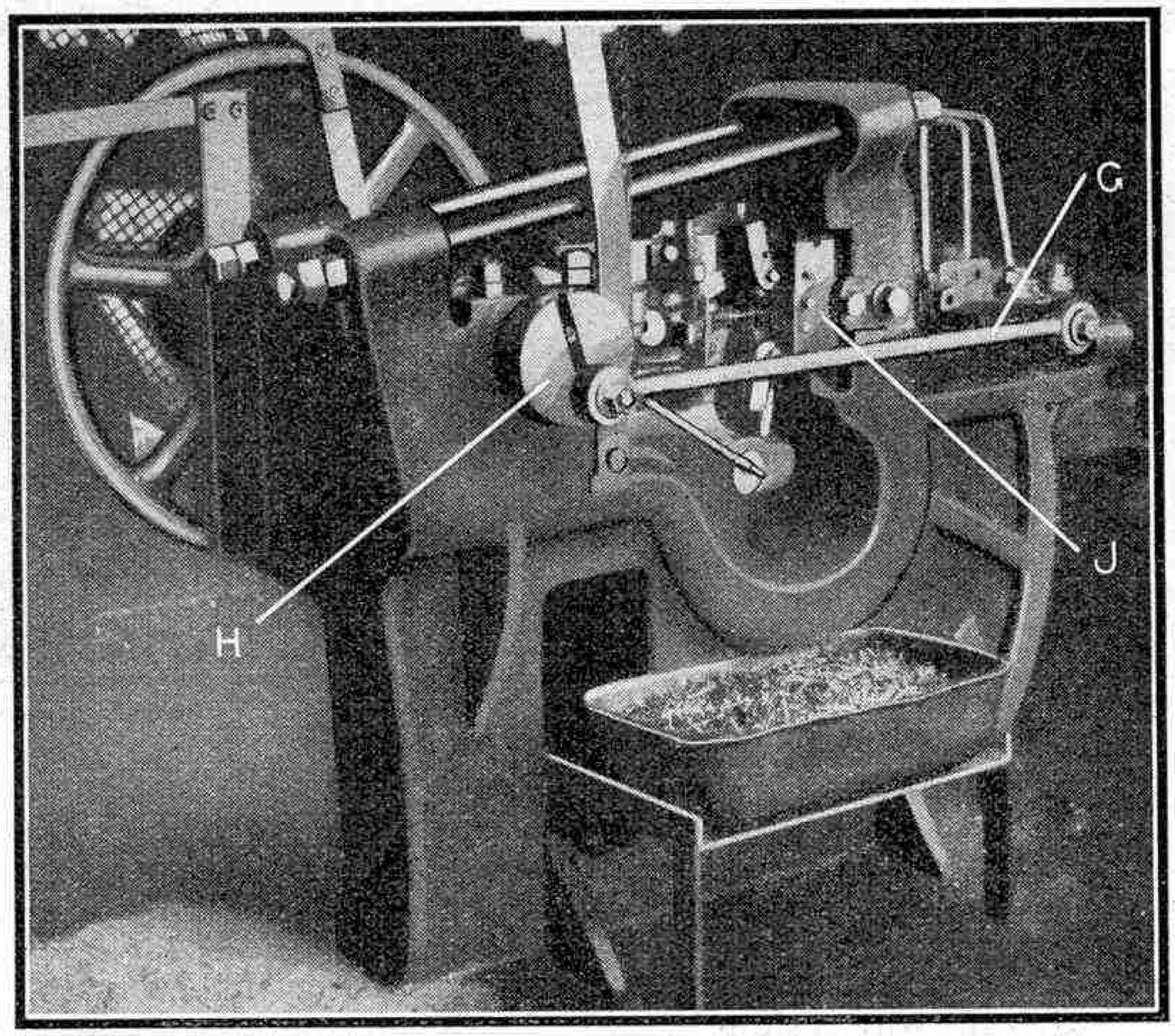
In discussing speed records of this kind questions of their value invariably arise. The creation of a flaming rocket to travel at more than 400 miles per hour may not seem to add greatly to human knowledge or pleasure, but it should not be forgotten that the people of 1895 were critical of, and even hostile to the crude horseless vehicles —"motor cars" seem scarcely the right description of them—then beginning to show themselves on the roads. Yet it was the efforts of the pioneers that made motor cars possible at all and their present reliability is very largely due to the demands of racing drivers for better designs and more efficient steels and other constructional materials.

The average speed of cars on roads to-day is at least equal to that of the winner of the most important race of 30 years ago. It is quite impossible to foretell with any certainty what conditions will obtain 30 years hence, but it is safe to say that road speeds will be greater than at present, even if they do not reach 200 miles per hour, and in spite of the objections of many people it cannot be denied that increased speed of travel brings with it incalculable benefits.

How Things are Made: Wire Nails

Machines Give 30,000 Hammer Blows per Minute

BEFORE the war the wire nail industry in this country was deliberately crushed out of existence by Continental manufacturers, who habitually made use of the British market as a dumping ground for their product. These manufacturers regarded it as a matter of the utmost importance that they should never allow this industry to raise its head in Great Britain. During the war our dependence upon foreign nails was a very serious matter, and in order to meet the emergency certain British firms installed plant of the latest and most efficient type. Notwithstanding this development the Continent still supplies this country with a great proportion of its nail requirements, and there is a steady stream of some 5,000 tons per month which, in certain circumstances, could be produced in this country.



Courtesy [*Rylands Brothers Ltd.*

Fig. 1. High-speed Nail-making Machine

The modern nail machine has reached a very high pitch of perfection as the result of intensive study and research, particularly in America and on the Continent. It is essential that nail machines should be built of the best quality of material and be thoroughly rigid in structure, for few classes of machinery are called upon to withstand so much strain and wear. Another essential is simplicity. Many machines contain over 600 parts, while some have as few as 200. Reciprocating parts should be easy of access and simple of adjustment, the latter factor having a great influence upon the effective running time. As a general rule nail machines are belt driven, as this form of drive possesses the flexibility necessary to take up shock and sudden loads.

The working speed of nail machines varies considerably according to the type adopted. Some makers favour a relatively slow-running machine and others high-speed presses. The machine speeds vary also according to the size of nails produced. The high-speed plant of Rylands Bros. Ltd., for example, is divided into approximately four sizes of machines, the speeds of which are respectively as follows :—

Length		Revs. per Minute
12″ to 6″	...	150
5″ to 2″	...	230
2″ to 1″	...	300
1″ and smaller		400

A nail is produced with each revolution and therefore the table will give some idea of the large output per machine.

One of the troubles of high-speed presses of this type is the heat generated by the constant hammering, and it will be appreciated that lubrication is of vital importance. Wherever possible automatic lubrication is adopted in preference to hand oiling, the latter being erratic, uncertain and wasteful.

To the initiated, on a first visit to a nail factory, the noise appears stupendous, and when it is remembered that 20,000 or 30,000 hammer blows per minute are being struck, this is not a matter for astonishment. A nail factory is one of the few places where deafness confers an advantage!

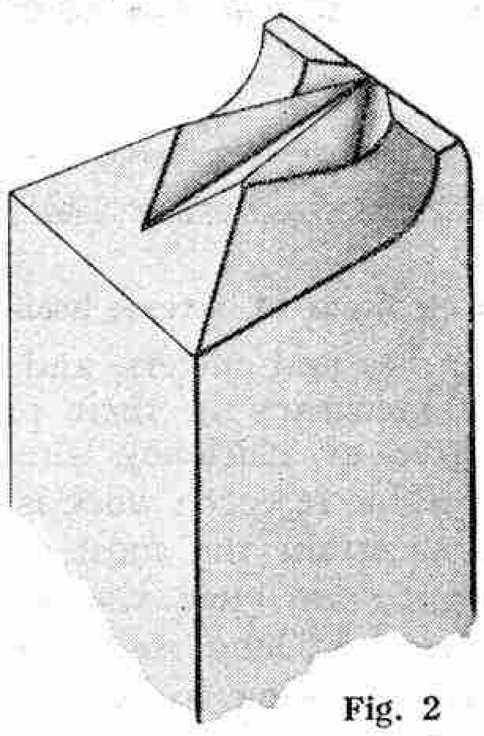


Fig. 2

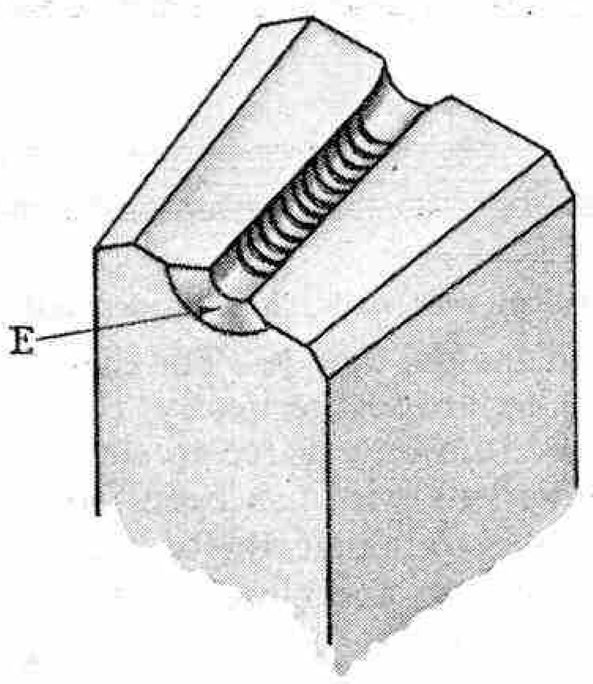
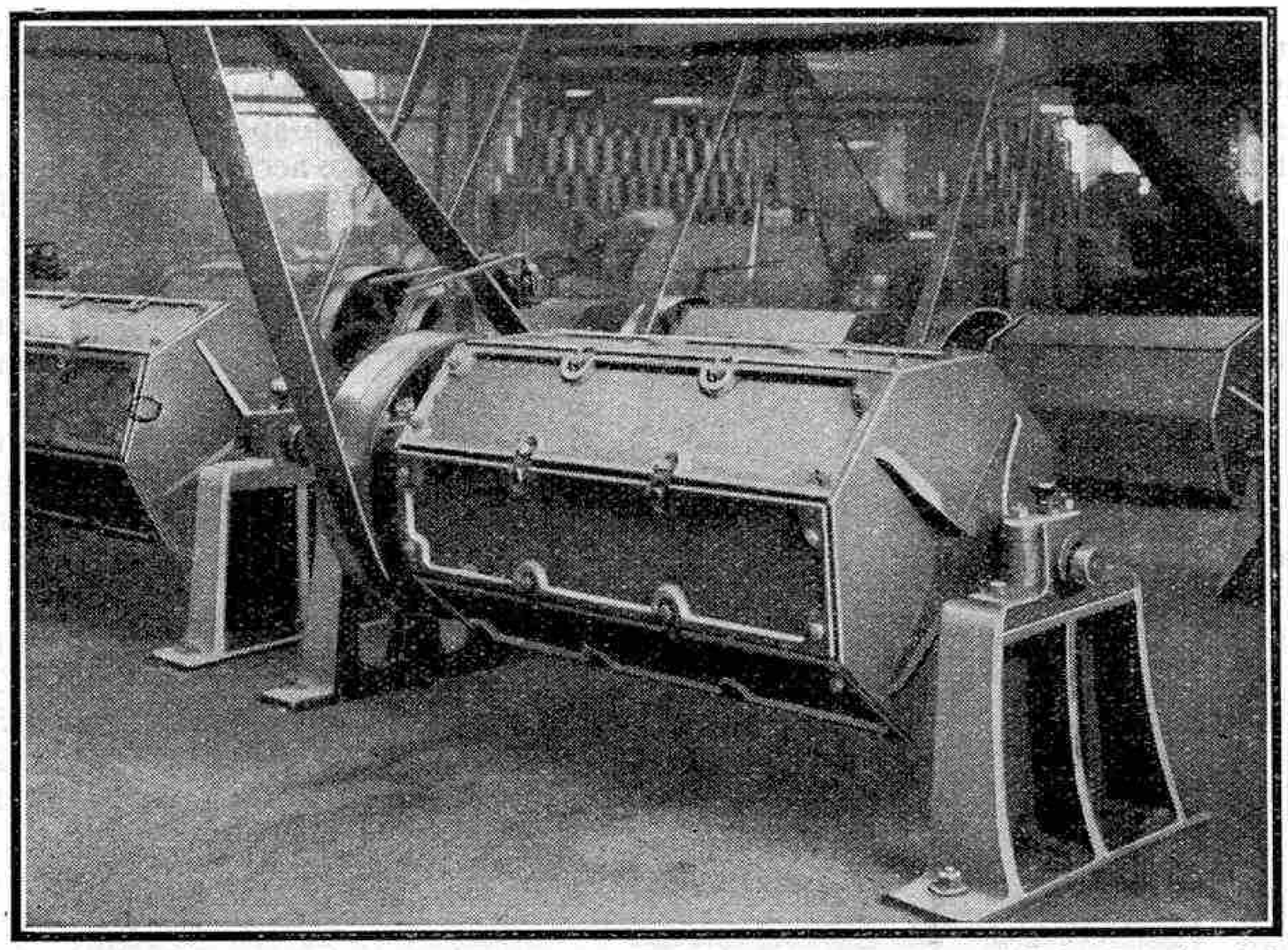


Fig. 3

The material from which wire nails are made is one of the most important factors in production. Particular care has to be taken to ensure that it is of the correct size and the right quality and temper, in addition to having a clean surface. With the exception of certain special types, nails are made from wire "hard drawn" from the "rod"—the thick wire to which the steel billet has been hot rolled—without

any inter-annealing. When nails with large heads are required, such as slate nails or lath nails, a much softer wire is needed and an inter-annealing process takes place at the requisite stage of wiredrawing in order to produce the desired result.

In a wire nail-making machine the principal parts are the straightening rollers, dies, cutters, hammer, knocker-off and length adjuster. The remainder of the machine parts are those necessary for making the principal parts function in the best and most economical manner.



Courtesy [*Rylands Brothers Ltd.*

Fig. 4. Typical Polishing Barrels

Fig. 1 shows a high-speed machine in which the operations are briefly as follows. The wire from a coil, weighing approximately 1½ cwt., is fed through straightening rollers, which are so arranged as to effectively "kill" the wire. From there the wire passes through the feed which consists of two cast steel pins, one fixed and grooved to take the wire and the other chisel-pointed and made to bear permanently upon the opposite side of the wire by means of a spring.

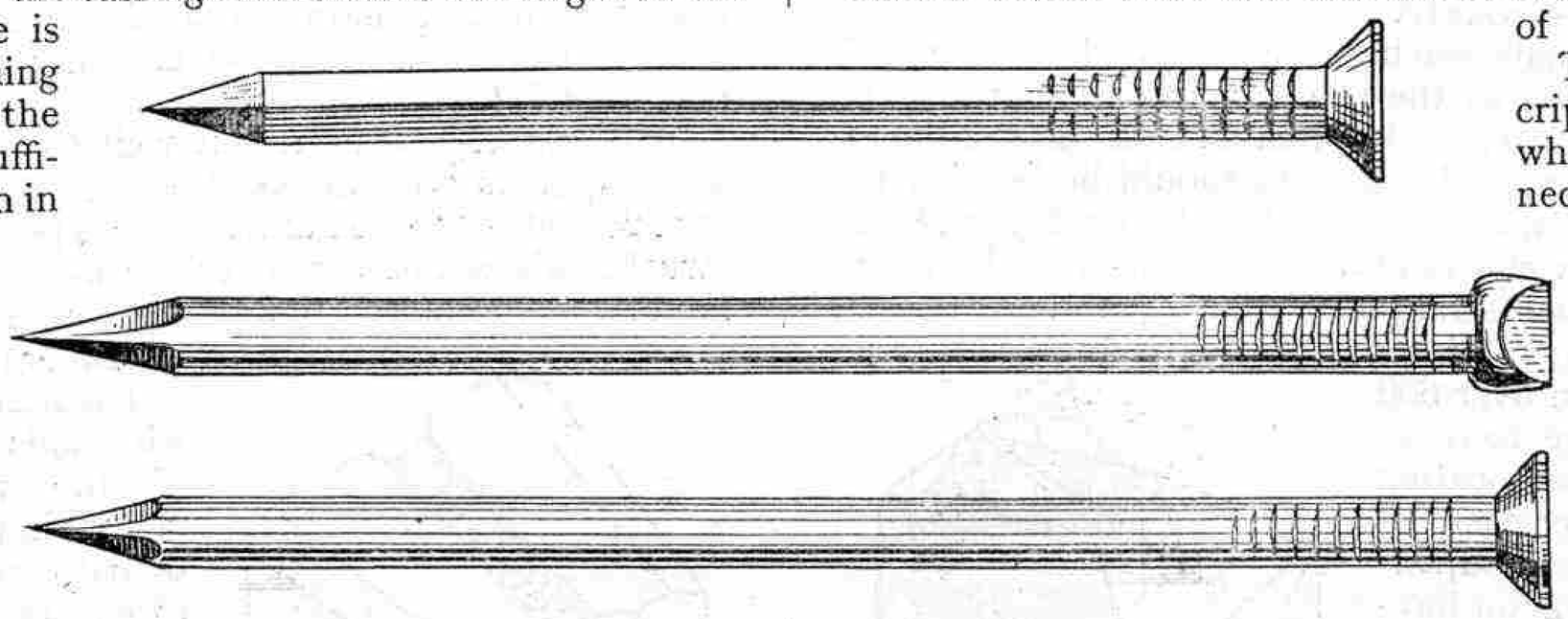
The feed and straightening rollers are mounted on a moving carriage, the travel of which is determined by the eccentric setting of the feed arm G operated from a feed disc H, which in turn is driven by the main shaft of the machine. The feed pin bearing on the wire ensures that this is fed forward automatically with each revolution and the travel of the carriage determines the length of the nail. Allowance is made in determining the travel of the carriage for sufficient extra length in the amount of wire to be cut off for making the head of the nail.

From the feed the wire passes through a hole in the frame of the machine and into the die-box J. The dies in this particular type of machine are set vertically, the top die being fixed while the bottom one is free to slide vertically in the die-box. When the wire has been fed through the dies, which are grooved to take it, the bottom die, actuated by a lever, is pushed up and closes on the wire. The length of wire now protruding from the dies is the length required to form the head. The wire is now firmly gripped between the dies.

At this point the hammer, working horizontally in a slide driven by the main shaft, is made to deliver its blow and the protruding wire is expanded into the countersinking of the dies, thereby making the head of the nail. The carriage then travels back, the spring feed pin allowing the wire to remain stationary until the limit of travel is reached. At this point the dies are open, the bottom die being pulled down by a weight attached to it.

We now have a continuous piece of wire with a head formed on the end of it. On the next forward travel of the carriage the wire is pushed through the dies and protrudes to the required length of nail, predetermined by the travel of the carriage. The cutting levers carrying the cutter boxes that contain the cutters then close upon the wire and in doing so cut off a point, the shape of this being determined by the type of cutters. Matters are so arranged that the cutting edges barely meet, so that when the knocker-off—a small lever working in conjunction with the cutter levers and operating horizontally—comes into action, the nail will fly off into the tray below.

Immediately following the knocker-off, the hammer heads up the next nail. The carriage then travels forward again and another nail is ready for cutting off. Thus it will be seen that one nail is made per revolution of the machine.



Three typical wire nails, showing depressions below heads to increase holding power

The foregoing description is somewhat long, and it is necessary to realise that all these operations take place in a fraction of a second.

The principal wearing parts of a nail machine are the dies and cutters, and these require the utmost care and accuracy in their preparation. Although a high degree of efficiency already has been reached, considerable research work is still being carried on in order to ascertain the most suitable steel for the purpose, keeping in view the advantages that automatically arise from long continuous runs without frequent resettings owing to failure of tools.

Fig. 2 shows the face of one of a pair of cutters used for making the ordinary diamond pointed nail. A pair of cutters in position on the machine can be seen in Fig. 1.

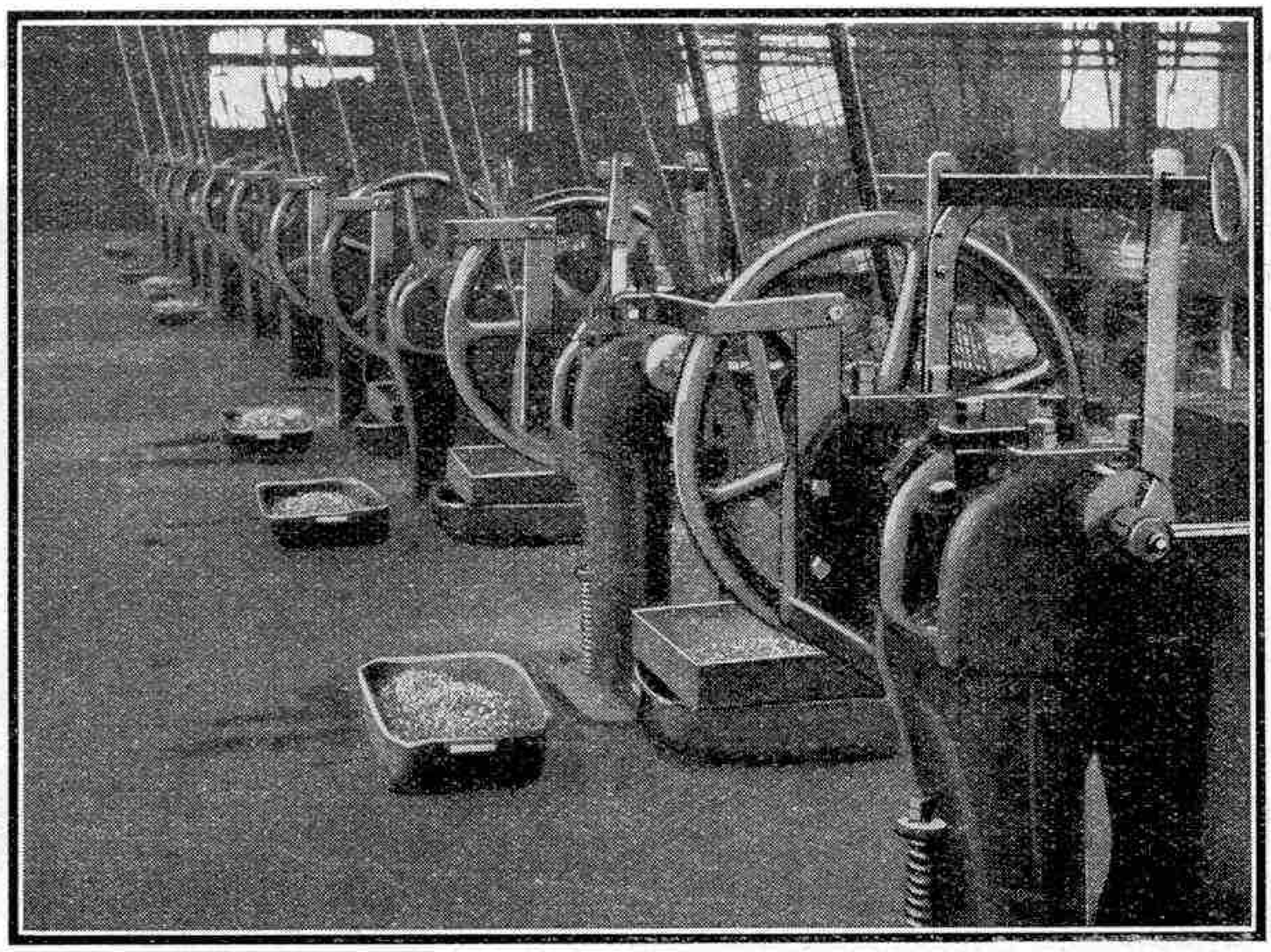
Fig. 3 shows the face of one of a pair of dies used in the manufacture of an ordinary countersunk headed nail. The dies are corded as shown, thus producing the horizontal depressions seen on an ordinary nail beneath the head, which are of great utility in giving the nail increased holding power. The cording of the dies is essential also to the process of manufacture, for increasing the grip on the wire while the heading is in progress. For making nails that are not countersunk under the head the dies would, of course, be made without the countersinking E.

The hammer for shaping the head of the nail takes many forms. For a plain head only, the face of the hammer would be perfectly plain, while for producing a chequered head the hammer face is cross-hatched. For the production of diamond, rose and brad heads, a special negative of the shape required is sunk into the face of the hammer.

As the nails are thrown out of the machine they are caught below in a metal tray, and after inspection are accumulated according to size and loaded on to a gravity roller conveyor, which takes them from the production shop to the polishing department. There the contents of the trays are poured into polishing barrels of the type shown in Fig. 4. The object of the polishing is to remove any traces of oil through contact between the wire and the machine, and also the coating that is essential in wiredrawing and any chippings or wings left on the points of the nails. After polishing, the nails are clean and bright and are passed forward to the packing department.

During recent years a considerable amount of research work has been carried out with the object of discovering some means of increasing the holding power of the ordinary wire nail. As a result of this research the interesting and important discovery has been made that the holding power of a nail may be practically doubled by giving it a coating of an adhesive mixture of special composition.

This operation, which is known as " cement coating," is quite a simple one. The polished nails are placed in a small barrel having a capacity of approximately 3 cwt. Appropriate quantities of the coating mixture—of which resin is the principle ingredient—are also placed in the barrel. When the loading has been carried out to the required degree the barrel is revolved over a gas flame until the resin has melted and the nails have become covered with an adequate coating of the resinous composition. The heating process then comes to an end and the nails are removed from the barrel and allowed to cool. While the cooling is taking place the coating gradually hardens, and when it is set completely the nails are ready for packing.



Courtesy] [*Rylands Brothers Ltd.*

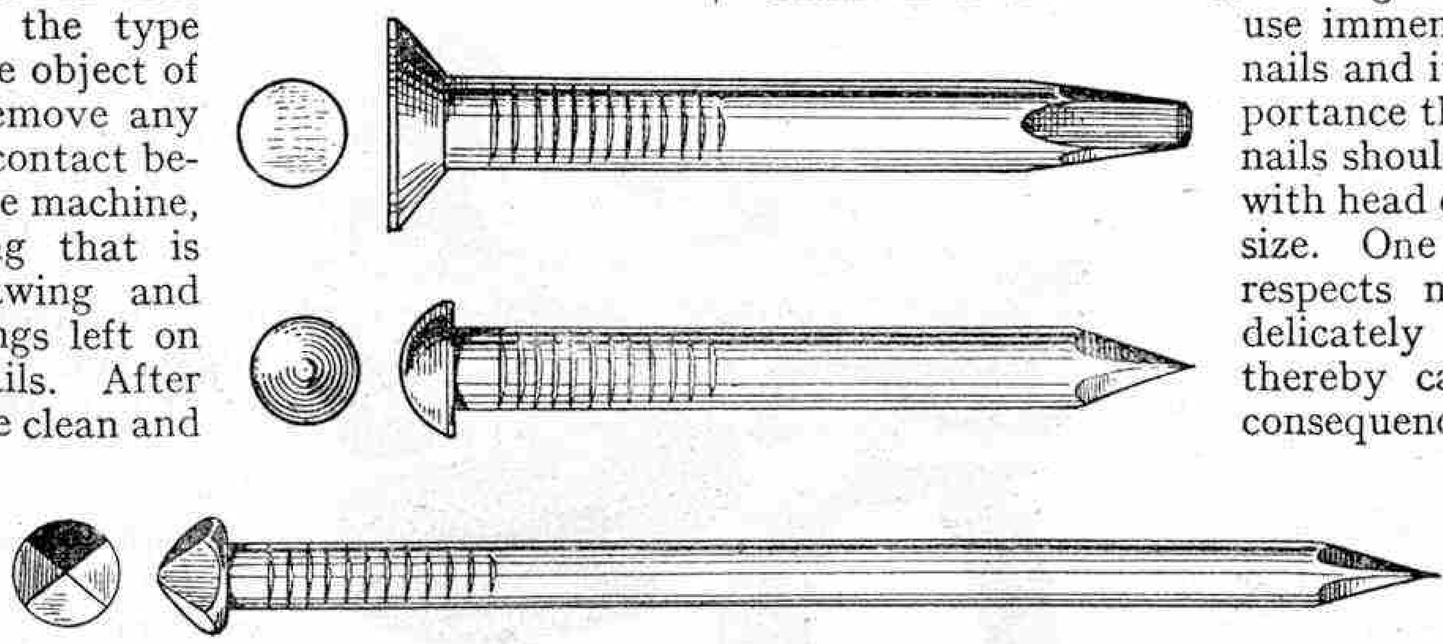
Fig. 5. Portion of modern Nail-making Shop

Cement - coated nails may be used for any purpose for which uncoated nails are suitable and their greatly increased holding power gives them many important advantages. For instance, any given piece of work may be carried out with fewer nails if the coated type is used, and further, the nails employed may be shorter or finer in gauge. It is obvious also that boxes and cases built up with coated nails must be much more difficult to tamper with and therefore far less liable to pilferage in transit.

Among the most exacting consumers of large nails are firms that pack their goods in wooden cases which are made in automatic box-making machines. Such firms use immense quantities of wire nails and it is of the utmost importance that every one of these nails should be accurately made with head centred and of correct size. One nail faulty in these respects may jam the rather delicately adjusted machines, thereby causing delay and in consequence more or less decrease in production.

For home requirements nails are packed in strong jute bags usually of 1 cwt. gross weight. If the nails are for export the packages usually take the form of iron or wood kegs to ensure safe transport.

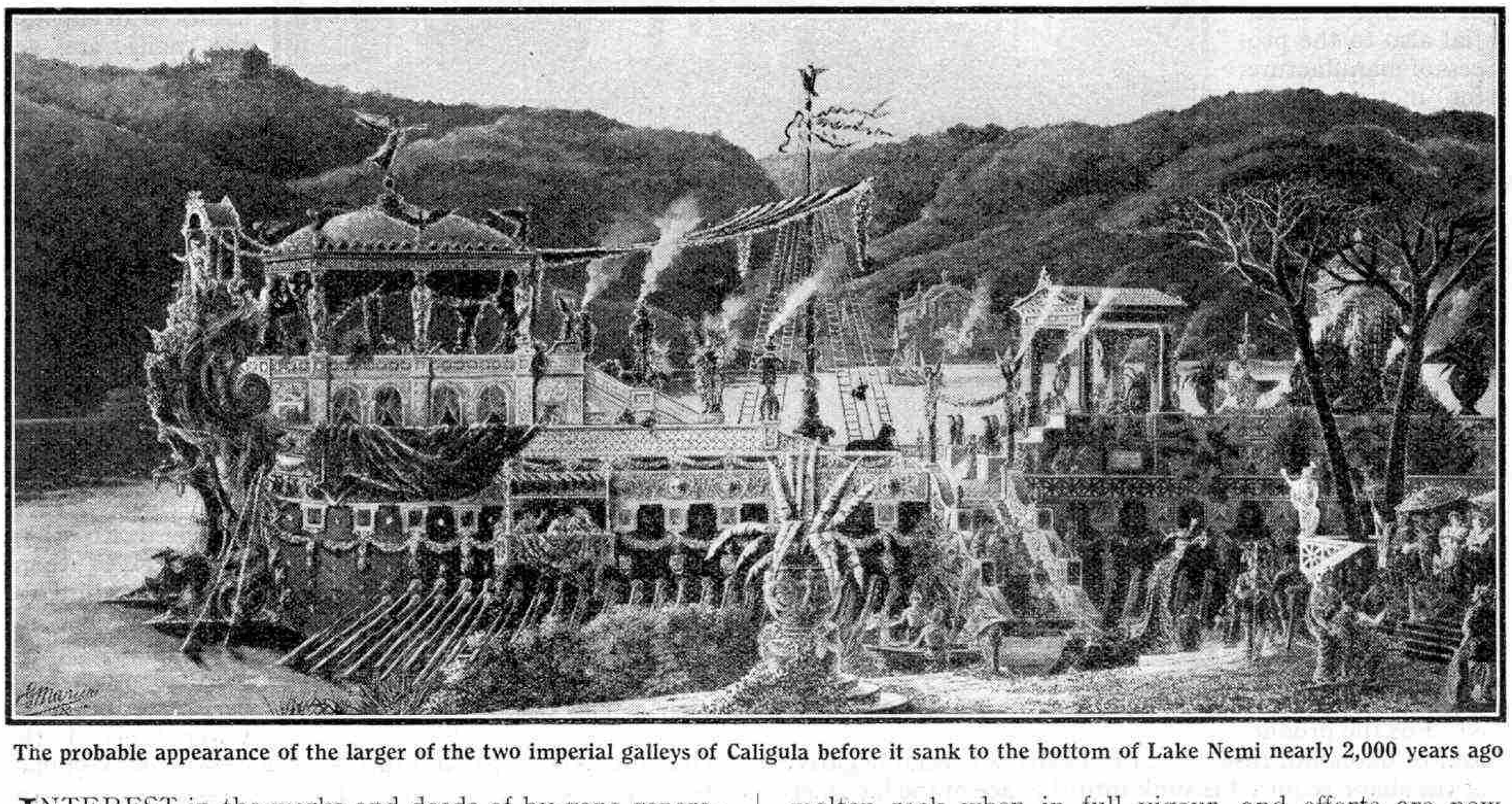
By insisting upon British nails British buyers are not only assured of quality, but have the satisfaction of knowing that they are supporting a new and efficient British industry. Every bag of nails leaving the works of Rylands Bros. Ltd., is clearly marked in black indelible ink with the word " British," also size and description of the contents.



Typical nails, showing different heads—bevelled head, rounded head and angular head

Sunken Relics of a Roman Emperor

The Treasure Ships of Lake Nemi

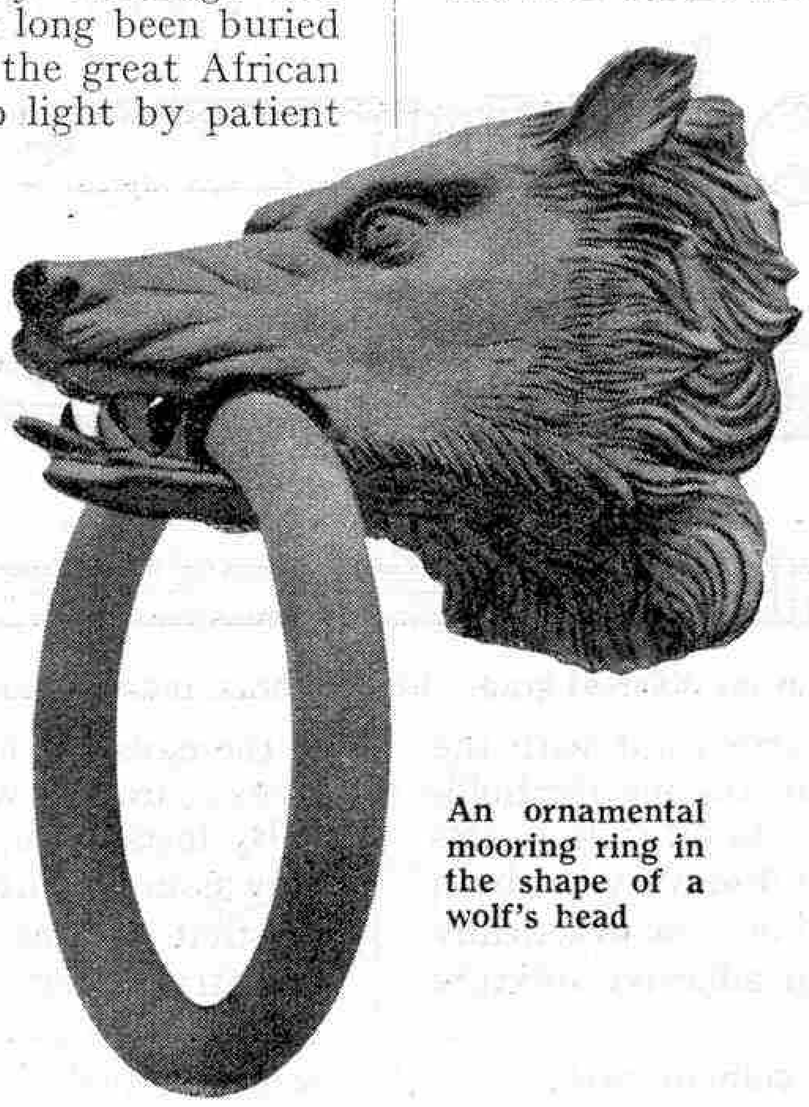


The probable appearance of the larger of the two imperial galleys of Caligula before it sank to the bottom of Lake Nemi nearly 2,000 years ago

INTEREST in the works and deeds of by-gone generations has never been keener than it is to-day, and attempts are being made to bring to light new facts about the daily life and history of practically every great nation of the past. Egypt has been the scene of much of this work. In that country buildings and tombs of thousands of years ago have long been buried under an accumulation of sand from the great African deserts and are now being brought to light by patient and laborious excavation. Many readers will no doubt remember the excitement caused by the discovery of the wonderful tomb of Tutankhamen. The excitement was thoroughly justified by the great increase in our knowledge of Egyptian history, religion and customs that resulted from the examination of the treasures revealed. Similar excavations carried on in Crete, Greece and Asia Minor have revealed the existence of civilised races that were only known previously by vague references in ancient literature.

In more recent times the cities of Pompeii and Herculaneum were overwhelmed by lava during a great eruption of Vesuvius in 79 A.D. These important Roman cities were hermetically sealed in the molten rock when in full vigour, and efforts are now being made to uncover them once more in order to reveal their wealth of artistic treasures.

Perhaps the most remarkable piece of antiquarian work ever undertaken, however, is now being carried out near Rome with the object of examining two vessels that have rested at the bottom of a lake for nearly 2,000 years. Their owner was the Emperor Caligula, one of the worst human monsters that ever lived. He it was who in a fit of temper wished that all the citizens of Rome had but one neck between them so that he might end the lives of the whole lot at one stroke!

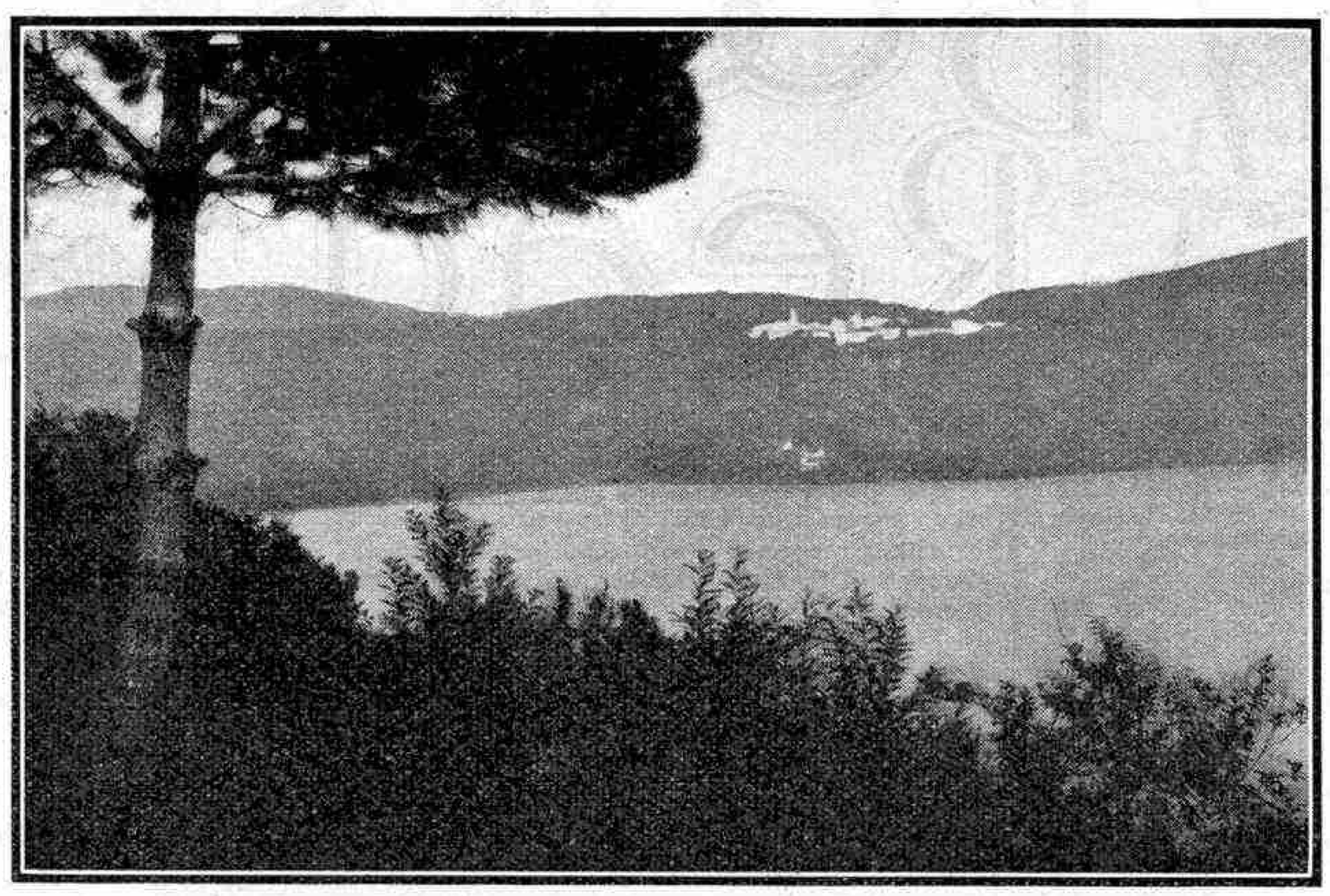


An ornamental mooring ring in the shape of a wolf's head

It was not necessary that Caligula should be moved to anger in order to display his cruel instincts. One of his chief forms of everyday amusement was that of having people killed in the greatest possible variety of unpleasant ways. Nobody was safe while he lived. One evening when he was dining with the two Roman Consuls he suddenly began to roar with laughter, and when asked the reason of his mirth he said that it amused him to think how easily he could have the throats of both Consuls

cut! All things considered, it is not at all surprising that his murder was the occasion of great rejoicing throughout Rome.

Among Caligula's many extravagances was the construction of the two vessels referred to. These were so lavishly fitted and decorated that they formed one of the wonders of the age. They floated on the placid surface of Lake Nemi, some 15 miles from Rome, for Caligula was far too much afraid of seasickness to venture on the Mediterranean in a vessel of any kind. One might have thought that on the calm waters of the lake the vessels would be absolutely safe, but eventually the enormous weight of bronze, gold, silver and marble used in them caused them to sink.



Lake Nemi, seen from the Villa Cesarini, Genzano

One of the accompanying illustrations is a reconstruction of the larger of the two vessels, based partly on examination by divers and partly on the descriptions that have been handed down to us. This vessel was a galley, fitted up in every respect like a small country estate. On the decks were summer-houses, temples, baths and galleries built of marble and lavishly ornamented. Trees and vines were planted on the terraces, while shrubs and flowers abounded everywhere. A great banqueting hall on board was the scene of some of Caligula's wildest orgies, and here probably he indulged in the almost incredible extravagances of drinking pearls in vinegar and serving up for his guests loaves modelled in gold.

Attempts have been made from time to time to raise these vessels, but with no success beyond the dragging up of bits of timber and metal ornaments of various kinds. Several of these ornaments were dragged up during the last century, especially between 1885 and 1889 by Lord Saville, then British Ambassador in Italy. We illustrate two of the articles that were recovered in this manner. These are a bronze lion's head with a mooring ring in its mouth and the head of a wolf bearing a similar ring.



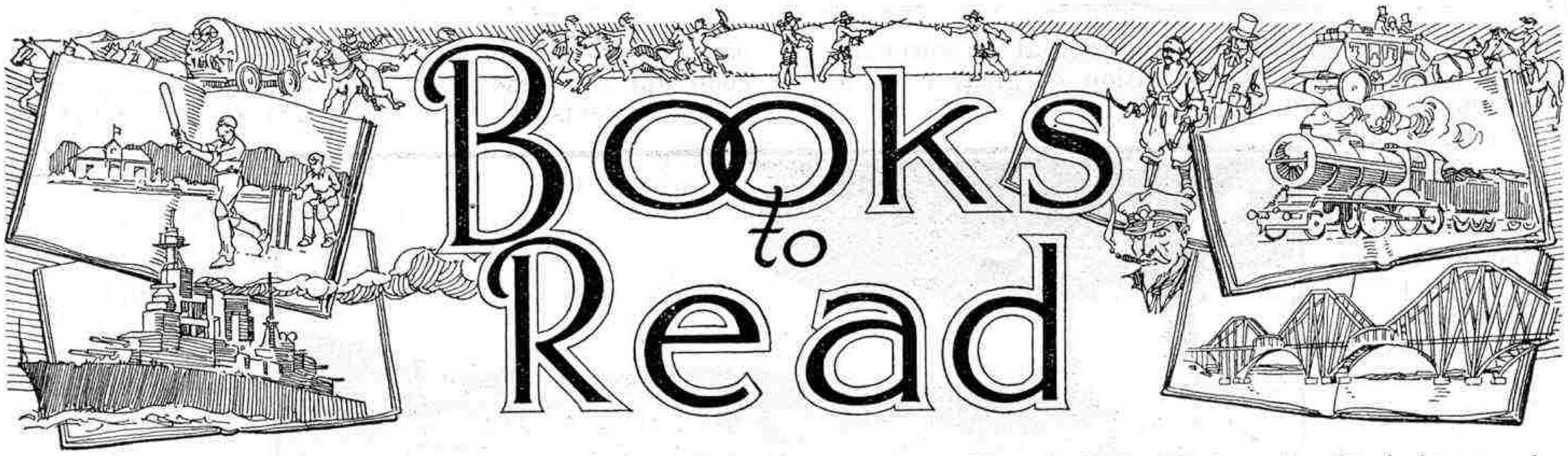
Bronze Lion's Head with mooring ring recovered from larger galley

Almost all the articles recovered so far are from the large galley, which in the process has suffered greatly from the grappling hooks of investigators. Divers have reported that the smaller vessel is in a fairly good state of preservation, however, and that its priceless ornaments and the equipment of the emperor's household are still intact. An organised salvage scheme was recently set on foot with the particular object of recovering this second vessel.

A difficulty that immediately presented itself was that the wood of which the vessels were built is in a decayed condition, which made it impossible to employ the usual methods adopted for raising sunken ships. At all costs serious breakage of the vessels during their raising to the surface had to be avoided, for this would destroy to a great extent the value of these relics of the Roman Empire. After careful consideration a method was decided upon which reverses the usual order of things. The ships could not be brought to the surface, and therefore it was decided to go down to the ships.

The scheme involves the entire removal of the water of the lake. The draining problem is by no means a simple one, but experts who have considered the matter are satisfied as to its feasibility. Sluices already exist by which the level of the water could be lowered, but better results are promised by a method that involves the emptying of the water into the adjoining Lake Abano, which is at a lower level. This will be an engineering feat of some magnitude, for it will be necessary to remove approximately 1,000,000,000 cubic feet of water.

The water will be conducted from Lake Nemi to the lower lake by means of a tunnel. The smaller galley then will be surrounded by a cofferdam in order to enable the work of cleaning and repairing to be carried on, after which the ship will be removed to a specially constructed dock. The tunnel then will be filled in and the lake allowed to refill in its own time. The contract for the work was signed by the Italian Premier in January last, and it is expected that the operations will be completed within a year. If the scheme is successful, the galley and its imperial treasures will form a magnificent museum of Roman life and manners.



Readers frequently write asking if we can recommend books that are both of interest and of use. On these pages we review books that will specially appeal to readers of the "M.M." We do not actually supply these books, which may be obtained either through any bookseller or direct from the publishers.—EDITOR.

"Astronomy"

By H. N. Russell, R. S. Dugan and J. Q. Stewart
(Ginn & Co. Two Vols. 10/6 each)

This book, which is written by three astronomers of repute of the Princeton University Observatory, U.S.A., is divided into two volumes. The first volume deals with the Solar System (470 pages and 183 illustrations) and the second with Astrophysics and Stellar Astronomy (463 pages and 124 illustrations). In each volume there are a number of useful tables, and volume 1 has a frontispiece in colour.

The present work is really a revision of the well-known "Manual" by Professor Young, who was also at Princeton University. So long an interval has elapsed since the book was first written that many alterations have been found to be necessary owing to the advances in astronomical knowledge. So extensive have been the additions, indeed, that the book has been practically re-written and considerably increased in length.

In writing the book it has been assumed that the reader has only an elementary knowledge of mathematics and physics, and the use of the calculus has been completely avoided.

Vol. 1 includes chapters dealing with Astronomical Systems of Measurement and Astronomical Instruments; Problems of Practical Astronomy; the Motion of the Earth; The Moon; The Sun; Eclipses; and the Planets. There is also a chapter on Celestial Mechanics and, of course, Comets and Meteors. The Origin of the Solar System is also dealt with.

Vol. 2 will probably be of greater interest to most people for it is in the science of astrophysics that some of the most wonderful discoveries of recent times have been made. Such chapter headings as the Analysis of Light; the Solar Spectrum; the Sun's Light and Heat; the Motions of the Stars and their Temperatures and Diameters; Star Clusters and the Milky Way, and the Nebulae indicate that the recent developments in this science have been fully treated. The information given includes many wonderful facts that must be of absorbing interest to everyone who has any regard at all for the celestial bodies. Concluding chapters on the construction of the stars and the evolution of the stars—including the suggestion that there are "more worlds than one"—and also some speculations as to the possible fate of the universe, give rise to many interesting thoughts.

It is no exaggeration to say that these two volumes form the best work on general astronomy published in the English language and no earnest student can afford to be without such a complete and brilliantly written work. Included throughout the book are some fine celestial photographs, and many diagrams make clear the more difficult points that arise.



This photograph of the Midnight Sun was taken at Etah, Greenland, at midnight in July. A series of exposures was made at 20-minute intervals and the Sun is seen reaching the minimum altitude at midnight. (From "Astronomy," Vol. I., reviewed on this page)

* * * *

"Holiday Haunts"

The familiar G.W.R. publication "*Holiday Haunts*" makes a welcome reappearance for the 23rd year in succession. This remarkable publication consisted of 334 pages in its first year; this year it reaches 964 pages. The book is certainly without parallel among railway publications, and it circulates not only in this country but almost all over the world, its circulation having grown from 40,000 copies in 1921 to 175,000 last year. It forms a complete handbook to the whole of the places of interest served by the G.W.R., with just those particulars that the average holiday-maker requires, including thousands of addresses of holiday accommodation. It is literally packed with illustrations excellently reproduced, and after glancing through these one realises the serious drawback of not being able to be in more than one place at a time! Anyone who cannot find in "*Holiday Haunts*" a place to suit him does not deserve to have a holiday at all!

"*Holiday Haunts*" may be obtained at the price of 6d. at all G.W.R. stations, agencies and bookstalls, or will be sent to any address by the Superintendent of the Line, G.W.R., Paddington, upon application, accompanied by a remittance.

* * * *

The 1928 "Wellcome" Photographic Handbook

This year's edition of the "Wellcome" Photographic Handbook more than maintains the excellence of past issues. The literary contents cover the whole range of photographic work and are written simply and directly so that there is no possibility of any misunderstanding. The frontispiece this year is a reproduction of a photograph of an Alsatian wolfhound produced by two-colour toning. The method by which this result has been obtained is explained in detail and indicates the wide possibilities in this direction.

The most valuable feature of the book, however, is that dealing with the exposure problem. The calculator has stood the test of many years' trial and may be regarded as the simplest and at the same time most accurate calculator of its kind. Used in conjunction with the lists of plate speeds and light values, it makes the estimation of correct exposure a simple matter even for an absolute beginner. An interesting article on exposures in cinematography will be appreciated by the rapidly increasing number of motion-picture workers.

The book may be obtained for 1/6 from any photographic dealer.

* * * *

"Hints for Holidays"

This year's edition of the Southern Railway's holiday guide, "*Hints for Holidays*," covers the seaside and inland resorts of the south and south-west of England. The book is very skilfully prepared and arranged, and scarcely a single item of essential information for the prospective holiday-maker is omitted. There are some hundreds of excellent illustrations of the places described, and in addition 12 particularly useful district maps are provided. There is the usual

extensive list of hotels, boarding houses, and apartments, arranged very conveniently with reference to the various resorts, and there should be little difficulty in making a suitable choice. The book costs 6d., and is obtainable at any Southern Railway Station or Enquiry Office as well as from the railway bookstalls, or will be sent post free for 10d. from the Indoor Commercial Manager, London Bridge Station, S.E.1.

* * * *

"The British Steam Railway Locomotive 1825-1925"

By the late E. L. AHRONS
(Locomotive Publishing Co. 30/-)

Although the late Mr. Ahrons was a busy engineer, engaged in many branches of important work, locomotives were his earliest and his greatest interest. His first article on North Western Engines was published when he was 15 years of age, and he has since written consistently on locomotives and railway matters.

The present book is a reprint of his articles that appeared in "*The Engineer*" in celebration of the Railway Centenary. It forms a comprehensive record of British locomotive practice from 1825 to 1925, and with its 480 illustrations and much additional information, the re-publication of the series in book form is a notable achievement.

Although historical works must of necessity always be written on common ground, there is a mass of interesting and valuable detail that has been omitted from most historical books on railway locomotives. This particular book is a notable exception, however, in that it includes a wealth of detailed matter, which has done its share in making history but is less generally known than the more outstanding facts. We cannot help feeling some regret, however, that the book did not begin at the "very beginning," for the history of the 18 or 20 locomotives built before 1825 by engineers other than Stephenson, would have benefited very greatly had Mr. Ahrons cleared up some of the points that still remain in doubt. Mr. Ahrons was noted for his extreme care in verifying even the smallest doubtful point and it is because of his persistent faculty in this direction that this history of the British locomotive is so complete and accurate to the smallest detail.

The book will be of the greatest value as an historical record, and as a standard book of reference it should find a place of interest in any list of "books to read" for those who find pleasure in the study of locomotive history.

* * * *

"Clay, and What We Get From It"

By A. B. SEARLE (Sheldon Press, 3/6)

To those who have learned to use their eyes, even as common and unattractive a thing as clay is worth looking at. The subject of this book has an interest peculiarly its own, for it exerts an influence on the lives of all of us to a far greater extent than we can realise. In view of this, it is astonishing to learn that our knowledge of clay is small and that the subject presents many problems that are either unsolved or only partially elucidated. Here, then, is wonderful scope for investigation by anyone who is sufficiently curious to study the subject.

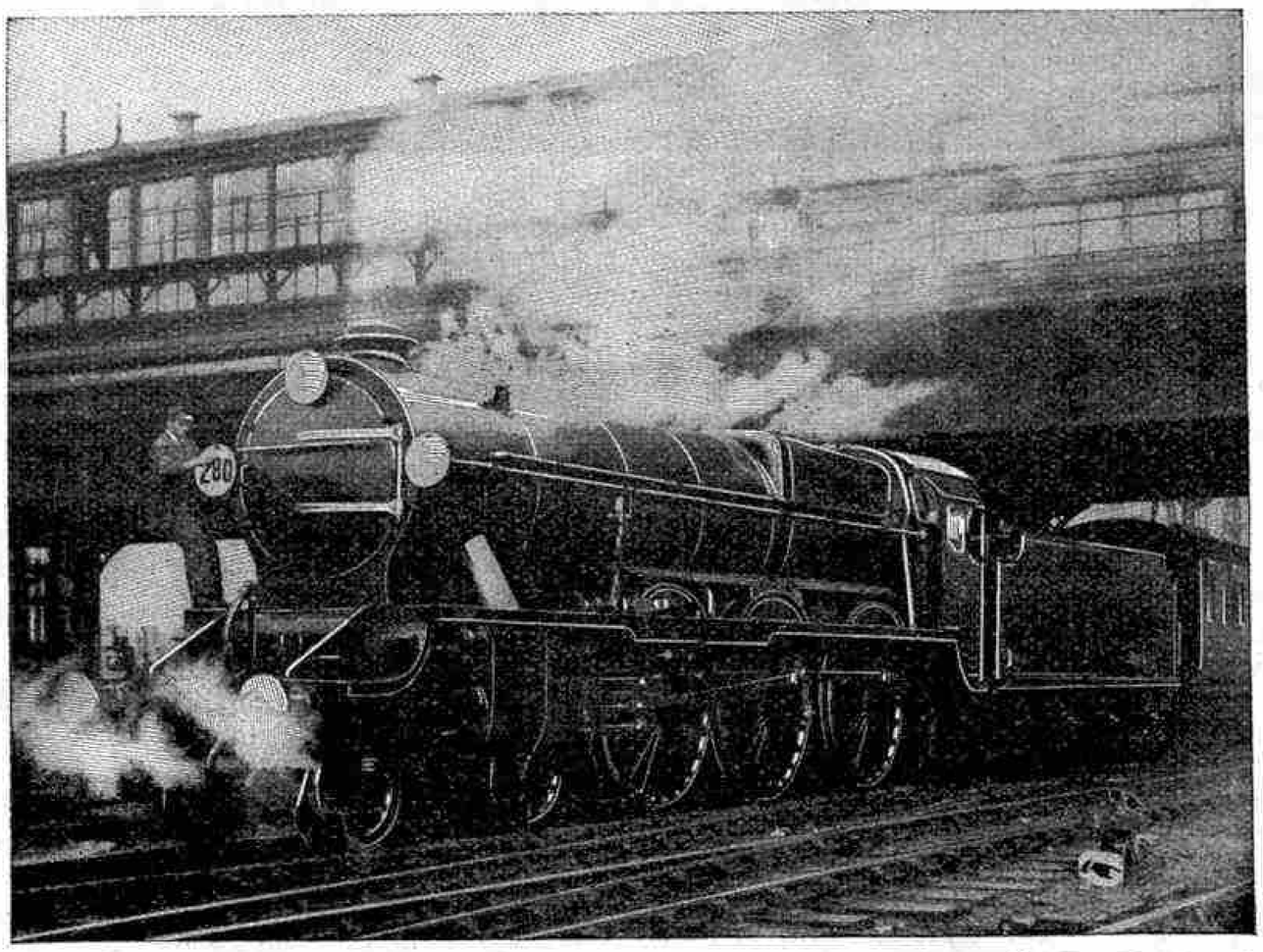
The author tells us that his interest in clay was first aroused one day at a famous school by seeing what appeared to be a fragment of a spear-head of polished stone, but which turned out to be part of the fossilised remains of a long extinct cuttlefish. From the detailed account of clay in all its forms one can well believe that he subsequently "ransacked the stores of knowledge accumulated by geologists, mineralogists, physicists, chemists and other scientists, as well as those of men engaged in what are regarded as more practical walks of life" in order to learn all that he could about this wonderful substance.

He tells us that clay is one of the most marvellous and fascinating materials found in nature. We should find life far less pleasing if we had to do without articles made of clay, whilst—what is of even greater importance—our food depends largely upon its special properties which permeate the soil.

The use of clay for purposes other than that of agriculture, dates from prehistoric times, for very early in the history of Man it was discovered that vessels made of wicker-work could be made far more useful by smearing them with clay obtained from river beds. These vessels, dried in the sun or by an open fire and used for carrying or storing water, were the primitive form of our pottery to-day. Much clay has gone through the kilns since those days, and while not much may be known about the scientific problems, methods of handling clays of various kinds to make them suitable for very fine ware are well known.

Then again, clay has long been of great use in building and even to-day mud or clay huts are still used by natives. In Devonshire and Leicestershire and other parts of the country there are cottages built of mud and still in use.

Altogether this is a very readable and informative book.



Ready for the run—the "Lord Nelson" at Waterloo (from "*The Book of the Railway*" by J. R. Hind, which will be reviewed next month)

"Essays of a Naturalist"

By SIR RAY LANKESTER
(Methuen & Co. Ltd. 1/6)

The aim of this book, one of Methuens' "Modern Classics," is to reproduce some of the best and recent literature in a popular form. The book consists of a selection of articles from the pen of one of our most distinguished naturalists, and the subjects covered are of general and varied interest. For instance, there are chapters on Dragons—including some interesting descriptions of the dragons and griffins of olden times—Vesuvius in Eruption; the Story of the Common Eel; Comets; Tobacco; Amber and Glaciers, in addition to other subjects.

We well remember the excitement aroused by the "Jumping Beans," to which strange vegetable one of the chapters is devoted. Some years ago these jumping beans could be bought for a few pence in London and elsewhere. Brought from Mexico, they were very popular and mysterious novelties and measured about one-third of an inch in length. The beans were apparently hollow and entirely without any visible opening, and when placed in a warm room or warmed on the hand, they commenced to rock and move with curious little jerks. Often these beans moved seven or eight times in the same direction and would progress a couple of inches on a flat surface. As Sir Ray Lankester says, the whole proceeding had a mysterious and uncanny aspect, for the beans have no legs—they are simply small smooth capsules—and yet they jump and seemingly "walk" with ease.

How and why these beans moved in this peculiar manner was not at all clear to those who bought the beans, and many and varied were the theories advanced by those to whom they were shown. As to the actual explanation—our readers are referred to the book (page 66).

Interesting New Books

We hope to deal with the undermentioned books in an early issue.

"EIGHT PLAYS FOR WOLF CUBS" *by* House & Brown (Brown, Son & Ferguson Ltd.), 1/6

"THE FAIR GOD" *by* General Lew Wallace (Fredk. Warne), 2/6

"THE CONSTELLATIONS AND THEIR HISTORY" *by* Rev. Charles Whyte (Griffin), 10/6

"KNIGHTS OF THE WHEEL" (Harrap), 3/6

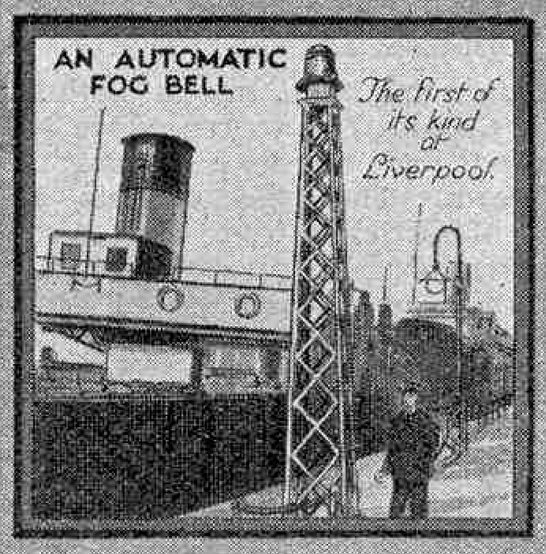
"SIR WALTER RALEIGH" *by* Milton Waldman (The Bodley Head), 12/6

"THE BOOK OF THE RAILWAY" *by* J. R. Hind (Collins), 6/-

"PLAY ACTING" *by* E. Stuart Monro (Brown, Son & Ferguson), 2/6

"SCIENCE FOR YOU" *by* J. G. Crowther (Routledge), 5/-

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Of General Interest

An Interesting Visitor from Space

The announcement of the appearance of a comet invariably arouses fear in nervous people and even the return after six years of the tiny Pons-Winnecke comet proved to be no exception. After the announcement that it had been seen was made, astronomers received many letters from people who were anxious to be told the worst! The chief fear seemed to be that the poisonous gases of the comet's tail would wipe out life on the Earth.

The Earth has often passed through the tail of a comet, notably in 1910 in the case of the famous Halley's comet, but we are still alive. The material of the tail of the largest comet ever seen is so thin that the light from the most feeble star ever obscured by a faint cloud is still visible through a thickness of millions of miles of tail. There is certainly a proportion of the poisonous gas carbon monoxide present, but this is so very slight as to be negligible. Neither from collision nor gas poisoning is there the slightest danger, and the only sign of the passage of the Earth through a comet's tail is an increase in the number of meteors visible.

In any case the comet that was the cause of the panic is a poor specimen from the point of view of size and certainly does not, in Milton's words, "Shake pestilence and war from its horrid hair." It very soon became quite invisible except with the aid of a powerful telescope and even then it was seen only as a fuzzy patch without a tail. It came nearest the Sun a few days before the total eclipse in June, and on the 26th of August it had passed round it and was then at its nearest to the Earth, when it was only 3½ million miles away—a very short distance, astronomically speaking. It is now once more on its outward way to obscurity in the depths of the heavens, from which it may be expected to emerge in its own modest way in the year 1933.

A good deal of interest is attached to this comparatively insignificant comet, however. It is strange that such flimsy bodies as the short term comets should survive so many returns to the Sun. One has actually disappeared. This was known as Biela's Comet, which was seen on its return in 1845 and 1874 to have broken into two parts and has never been seen since. In its place we may get an extraordinary shower of millions of meteors of great brilliance every seven years. Such a shower was seen in 1885.

Pons-Winnecke has threatened to behave in the same manner. It was first seen by an astronomer named Pons on 12th June, 1819, and was then lost. In 1858 Professor Winnecke, of Bonn in Germany, discovered what he thought was a new comet, but at a later date observations showed that it was actually Pons' comet that he had re-discovered after it had been lost for 40 years. This accounts for the double name of the wanderer. Calculations showed that its reappearance should take place about every six years, but it did not turn up again until 1869. Since then it has appeared very spasmodically and fears have arisen that the fate of Biela's Comet has overtaken our visitor of this year. Already there are signs of a meteor shower along its track and a few returns should make it plain how far the breaking-up process has gone.

Over a Hundred Years Ago!

"The inhabitants of Blackburn are now in the most distressed state. 7,000 looms are unemployed, and nearly 14,000 persons are dependent on the bounty of their neighbours."—"HANTS ADVERTISER," 24th April, 1826.

"We learn that a great number of weavers and others in this town (Blackburn), have been prevailed upon, in consequence of the distress of the times, to embark to America, and that others are preparing to follow their example."—"BLACKBURN MAIL," 1st Sept., 1826.

A Mystery of the Past

"A man engaged in splitting timber for rail-posts, near Kelsall, in this country, a few weeks since, discovered in the centre of a large pear tree, a living bat of bright scarlet colour, which he foolishly suffered to escape, from fear, being fully persuaded (with the characteristic superstition of the inhabitants of that part of Cheshire) that it was a 'being not of this world.' The tree presents a small cavity in the centre, where the bat was enclosed, but is perfectly sound and solid on each side."—"LIVERPOOL MERCURY," 6th Dec., 1826.

The Last of the Pirates

"Admiral Sir D. Neale has just arrived at Malta with twenty prisoners (pirates), taken on board a private vessel; he has witnesses with him to prove their guilt."—"THE TIMES," 4th Dec., 1826.

"Boys Will be Boys"—Even a Century Ago

"The old woman, Mary M'Mullen, last week failed in her task to walk 92 miles within 24 hours on the Spilsby Road. During the evening a party of boys and loose characters thronged the spot, and very much annoyed the old woman by crossing her path and trampling on her heels. She was finally led up to the mark by two men at eight minutes past the time."—"THE TIMES," 4th Dec., 1826.

Home Life in a Golden Eagle's Eyrie

The young cuckoo is well known to eject the young birds in whose rightful home it has grown up, but it has recently been discovered that there is a bird that outdoes even the cuckoo. This is the golden eagle. It has often been remarked that two eaglets are usually hatched but only one is reared, and the reason seems to be that one is killed by the other.

This explanation of the disappearance of one eaglet has been suggested by the well-known naturalist Mr. Seton Gordon, who succeeded in keeping watch on the eyrie of a pair of golden eagles for a full month. He built a hiding place near the eyrie from which he was able to make observations unseen by the pair of birds.

Of the two eaglets under observation the hen was the larger and stronger, as is usual with birds of prey. She very quickly established her ascendancy in the home and attacked her brother with such murderous ferocity that Mr. Gordon decided that Cain was the only suitable name for her. Her brother, of course, became Abel automatically. He never provoked an attack nor did he attempt to defend himself from the furious peckings to which he was subjected, simply assuming a sullen expression when he saw that Cain was again preparing to hustle him round the eyrie. The down plucked out by the bad-tempered female not only littered the eyrie but was spread for yards along the heather below the tree in which the eyrie was built. On one occasion she tore out such a large tuft of Abel's down that it stuck to her beak, annoying her immensely for a long time before she succeeded in getting rid of it.

The older birds seemed to take the persecution of the weaker eaglet quite as a matter of course. Abel survived several weeks of this ill-treatment, though the watchers fully expected each morning to find him dead.

Blind Boy as Radio Announcer

A novel broadcasting item has been adopted at the Vancouver Canadian National Railway Radio station in which a blind boy, 15 years of age, describes an imaginary train journey. This realistic item has aroused great interest amongst listeners over a wide area. The noises and excitement of the train starting and stopping, the warning signals, and all the incidents of the journey are realistically reproduced. To add to the interest of this novel "journey" stops are made at various stations en route and various children resident in the district are "visited."

Ronald Matthews, the boy announcer, has been blind from birth, and has his notes for the "journey" prepared in braille. He is an accomplished musician and has passed two examinations of the London Academy of Music, so that it will be seen he has more than one interest in life. Naturally Ronald is popular in Vancouver, and he has become one of the best-loved figures on the Pacific coast.

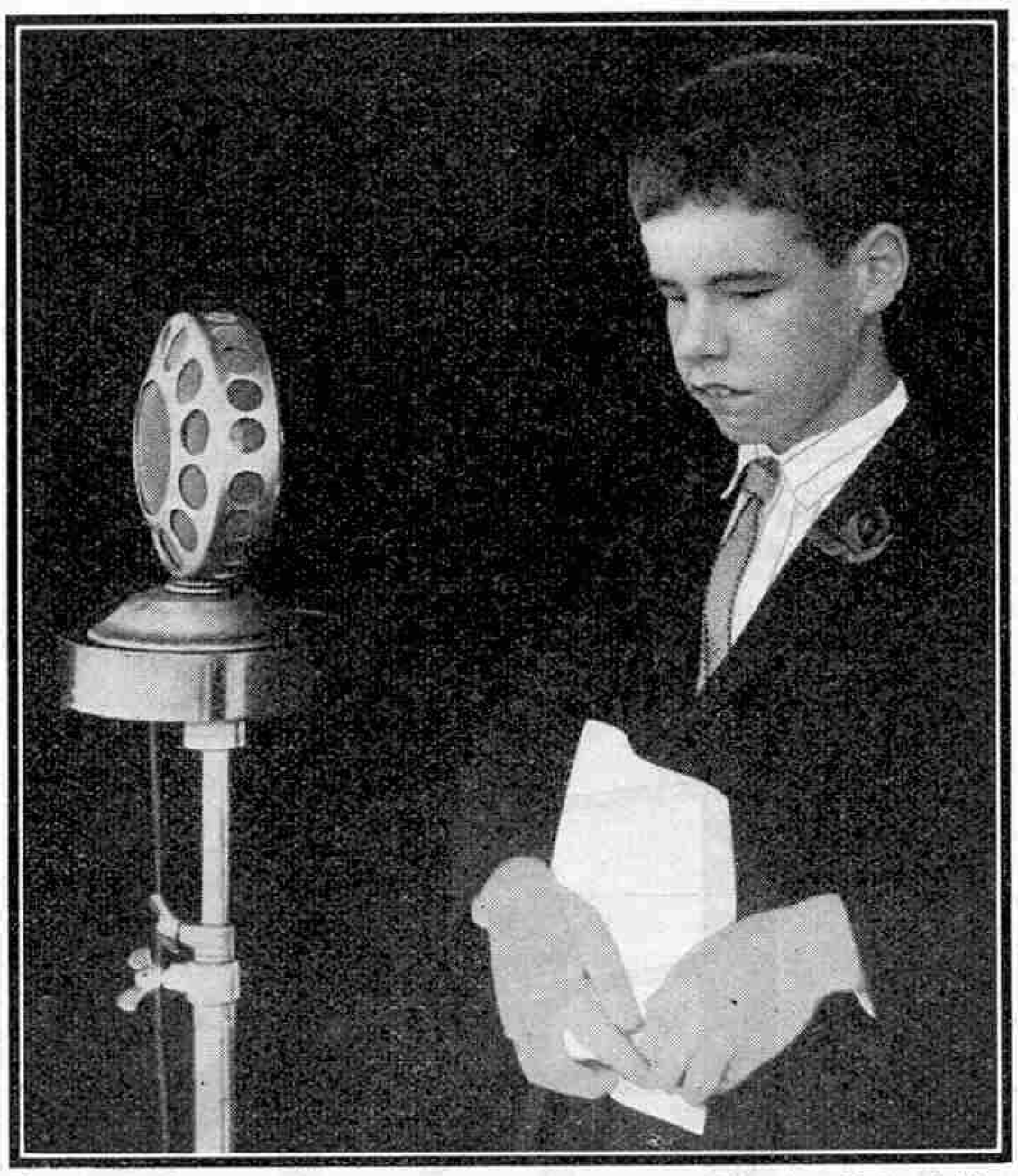


Photo courtesy] [*Canadian National Rlys.*

Ronald Matthews, the blind "conductor" of an imaginary train. Ronald is reading his braille notes with his finger tips (see paragraph on this page)

Matches Invented Over 100 Years Ago

It is difficult to imagine a world without matches, yet it is only 101 years since the friction match was invented by John Walker of Stockton-on-Tees, who sold his first box on 7th April, 1827. Each box contained 100 matches and sold for 1/–!

Flint and tinder had been in use for centuries, but various substitutes had been suggested before Walker's invention. These usually made use of phosphorus along with a tinder box. In 1788 the following quaint advertisement appeared in the London "*Morning Post*":—

"For Travellers, Mariners, Etc.—Promethean Fire and Phosphorus.—G. Watts respectfully acquaints the public that he has prepared a large quantity of matches of a portable and durable kind, with Promethean Fire, paper, and match enclosed, all admirably calculated to prevent those disagreeable sensations which most frequently arise in the dreary hour of midnight, from sudden alarms, thieves, fire, and sickness."

Rebuilding the Bank of England

The Bank of England, founded in 1691 by William Paterson, is now being rebuilt and many ingenious devices are being incorporated in the new structure as a protection against robberies. The original bank was housed in a one-storied building erected by Sir John Soane in 1788. The exterior is without windows and has very little ornament.

There is always a stock of many million pounds' worth of gold and silver in the vaults and, for security's sake, a detail of soldiers from one of the Guards' Regiments is on duty every night and can be seen entering the Bank shortly after 6 p.m.

Though the Bank is a private institution it enjoys exclusive privileges in the issue of bank notes, etc. The principal offices are open to the public, and visitors are always interested in the quaint uniforms of the messengers.

Buffalo Bill Museum

February 26th was the anniversary of the famous Buffalo Bill's birthday, and was declared a state holiday in Wyoming.

The State has purchased a tract of land upon which is being erected a duplicate of Colonel Cody's old ranch homestead group, which is to be made into a museum of pioneer Americana in tribute to the hero. The site of this museum is located directly in front of the Shoshone Canyon, with surrounding snow-peaked mountains —a country of which every tree and stone calls up memories of the famous frontier pioneer. The spot on which the museum is to be built is a real bit of the old West, where Indians fought in a desperate effort to hold the Big Horn Basin.

The log house in which Colonel Cody lived will appear exactly as he used it. A library of frontier and pioneer literature will be assembled, and outside there will be a bunk house, corrals, sheds, barns, big swinging ranch gates, and piles of buffalo horns. The last is a particularly apt exhibit, for Buffalo Bill got his name by killing 4,280 buffalos in 18 months to supply the employees of the Kansas Pacific Railroad with meat. He became known to the world at large as the organiser of the famous show "The Wild West," illustrating life on the frontier.

More Uses for Rubber

Every day seems to produce a new way in which rubber can be used with advantage. A well-known motor car company is making use of rubber pads to diminish vibration and road shocks, and now it seems that rubber is capable of replacing metal in the bearings of engines.

Experiments have been made in America in which the metal bearings of the propeller-shaft of a Diesel-engined tug were replaced by rubber. In this position the rubber only needs lubrication by water, whereas the ordinary soft metal bearing requires an elaborate system of oil lubrication.

After several months' use very little wear could be detected in the rubber bearing in spite of the fact that loads up to 375 pounds per square inch had been used. Vibration and noise are, of course, greatly diminished, while the propeller shaft practically keeps itself automatically centred. One great advantage is that grit or sand cannot damage the bearing, as any small hard particles introduced simply sink into the rubber.

Pitfalls of "fakers"

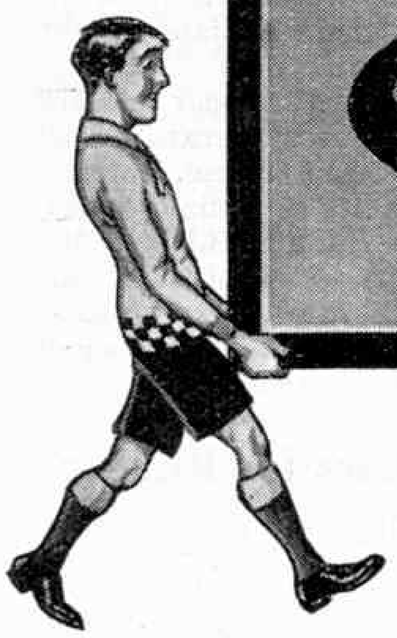
The faking of pictures and forgery in general are not easy in these days of X-rays and the microscope, but very often detection follows a very simple error committed by the forger. Colours, for instance, are the chief of the picture-faker's pitfalls. Many of the substances now used for colours, such as Prussian blue and cobalt, were not known to the old masters, but it is frequently found that forgers make use of them in retouching their work or in making imitations. Other picture forgeries have been betrayed by the use of modern fabrics on which the alleged "old master" has been painted.

The presence of modern screws in wood has betrayed many fakes, just as mahogany in "antique" furniture of the Stuart period has betrayed furniture fakers, for this wood was not used for furniture in Europe until later times. The most amazing instance was a forged Treasury note which was detected by the simple fact that the back of it was quite blank!

The Early Bird

About the middle of February a student of natural history saw a fine thrush carrying hay to the top of a small rhododendron bush. He continued to watch the bird's activities and observed that by the end of the month a nest had been completed and the eggs laid.

Incubation began at the beginning of March, and very severe weather followed immediately. The snow and sleet blew unmercifully, but nevertheless the hen remained seated on the nest with her wings outspread completely covering the nest and the eggs. The male bird spent practically all his time on an upper branch of the bush seeking to shelter his mate from the falling snow, and the pertinacity of the birds was rewarded by the successful rearing of their young in spite of the inclement conditions.



Suggestions Section "Edited by Spanner"



The ideas printed in the "Suggestions Section" should prove a real help to thousands of Meccano enthusiasts. Often we receive letters from readers who describe how they have solved some knotty problem or evolved an interesting model after studying some of the ideas that have appeared. We shall always be pleased to receive further contributions for the "Suggestions Section." Cash payments are made for Suggestions published showing special merit. Contributions should be accompanied by clear photographs or drawings and should be addressed to "Spanner," c/o The "Meccano Magazine."

(120)—Siemens' Chronometric Governor

(*S. Morris, Paddington, W.*10)

IN almost every type of engine, certainly in all steam engines, an efficient means of regulating the speed must be provided.

A simple engine of the piston and cylinder type can, of course, be regulated by hand, but for the finer adjustment of speed some form of automatic governor is essential, and as the size and power of the engine increases, so the governor mechanism becomes more elaborate. A simple case that will show the importance of efficient governing is provided by the marine engine. In a rough sea the ship's propeller may be lifted completely out of the water, owing to the pitching of the vessel, with the result that the engines are freed suddenly of an enormous load. If they were not promptly checked by an automatic governor immediately this happened they would "race" at a terrific speed, with grave consequences to the ship as well as to the engines.

As a rule, steam engines are fitted with centrifugal governors, generally of the Watt type. These consist essentially of heavy weights attached by short connecting links to a rotating shaft. If the speed of the engine increases the weights, under the influence of centrifugal force, tend to fly further away from the shafts and this movement is employed to partially close the steam admission valve. Owing to the smaller amount of steam admitted to the cylinders, the speed of the engine then drops until the weights resume their former position. A Meccano model of this type of governor is described under Standard Mechanism No. 87.

A disadvantage of the ordinary type of centrifugal governor is that its effect is not instantaneous. A sudden increase or decrease in the load may cause quite an appreciable fluctuation in the speed of the engine before the governor weights rise or fall, as the case may be, and so operate the throttle valve. To overcome this difficulty many devices have been invented from time to time, and perhaps one of the most ingenious and effective, as well as the most interesting for Meccano demonstration purposes, is the Siemens' Chronometric Governor.

This governor makes use of the differential principle, which was introduced by Sir William Siemens about the middle of last century, in conjunction with the conical pendulum.

The Meccano model illustrates the sensitive action of the governor in a clear and unmistakable manner. It is practically impossible to turn the operating handle with a sufficiently even torque to keep the valve counterweight at a constant height. The counterweight moves constantly up or down, registering the slightest fluctuation in the power imparted to the handle through the hand.

The best plan is to drive the model by means of a Meccano Electric Motor. For this purpose, a Pulley or Sprocket Wheel should be secured to the top of the vertical Rod, in place of the handle, and connected to the Motor by means of an endless cord or length of Sprocket Chain. A Meccano Resistance Controller should be connected in series with the Motor so that the speed of the latter may be varied as required. In this way the operation of the governor can be demonstrated in a very interesting manner. The slightest movement of the Controller switch arm will produce instantaneously a movement of the Crank 10, so indicating the change in the speed of the Motor.

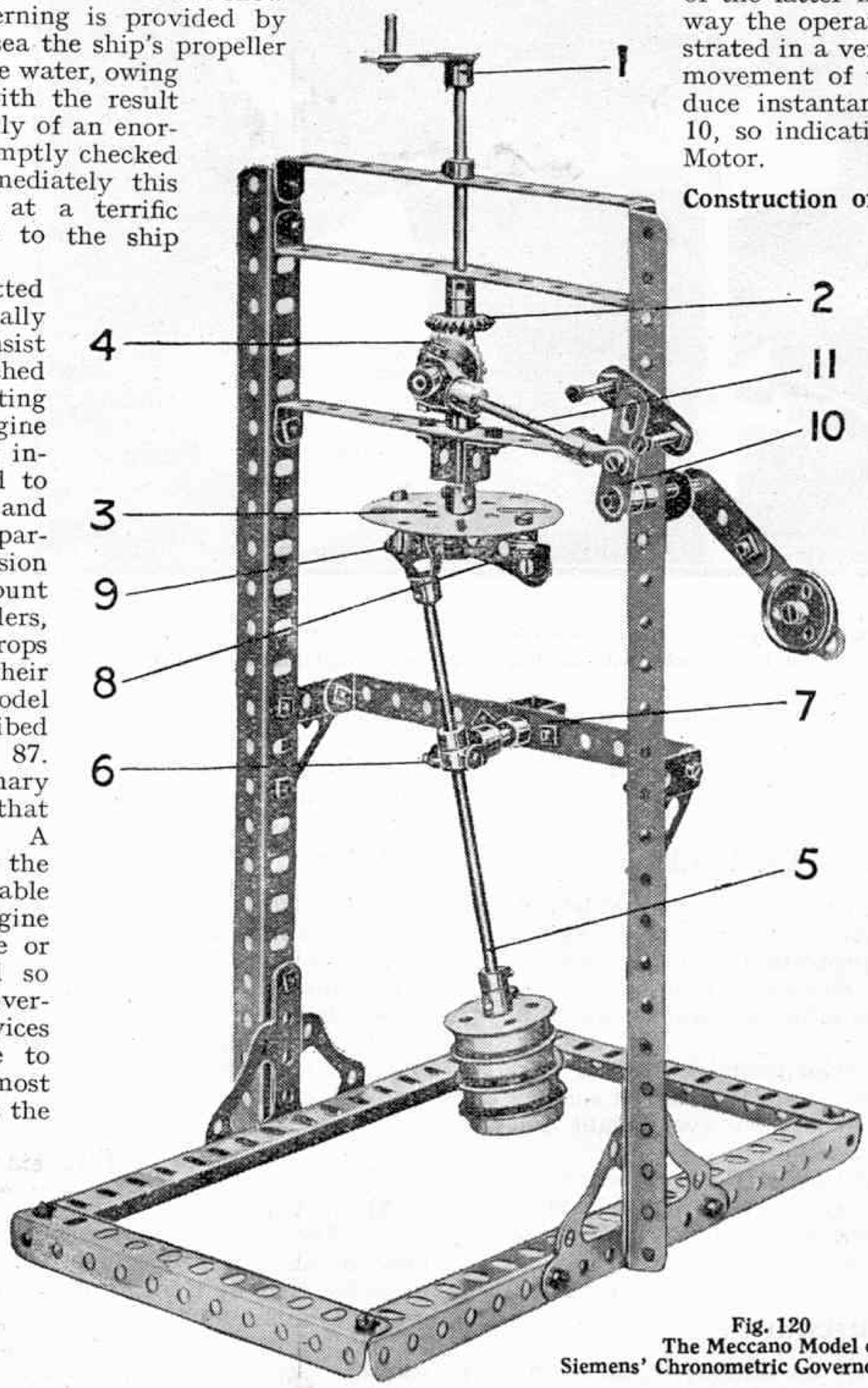


Fig. 120
The Meccano Model of Siemens' Chronometric Governor

Construction of the Model

The operating handle 1 is secured to the top of a $3\frac{1}{2}$" Rod that is journalled in two $5\frac{1}{2}" \times \frac{1}{2}"$ Double Angle Strips bolted between the upright $12\frac{1}{2}$" Angle Girders. The $\frac{7}{8}$" Bevel Wheel 2 is secured near the lower end of this $3\frac{1}{2}$" Rod.

The Face Plate 3 is fastened to the lower end of a $1\frac{1}{2}$" Rod that is journalled in a third $5\frac{1}{2}" \times \frac{1}{2}"$ Double Angle Strip and in a Double Bent Strip, as shown, and a $\frac{7}{8}$" Bevel Wheel is secured near its upper end. The extreme ends of both the upper $3\frac{1}{2}$" Rod and lower $1\frac{1}{2}$" Rod are inserted in opposite ends of a Coupling, in the centre transverse hole of which is secured a 2" Rod carrying the $\frac{7}{8}$" Bevel Gear 4. The two first-mentioned rods are free to rotate in the ends of the Coupling and the Bevel 4 meshes with the two other Bevels. This mechanism resembles an ordinary epicyclic gear train. It may make the construction of the unit more clear if we refer readers to the differential gear in the new Meccano Motor Chassis (see Special Instruction Leaflet, or "*M.M.*" for February, 1928) the construction of which is similar in many respects.

When the handle 1 is rotated the drive is transmitted via the Bevels 2 and 4 to the third Bevel on the vertical $1\frac{1}{2}$" Rod, and therefore the latter is driven in the reverse direction to that in which the handle 1 is turned. The Bevel 4 is quite free to rotate about its Rod, of course.

The conical pendulum 5 (so named because the area described by its swinging motion is of conical shape) consists of a 5" Rod weighted at its lower end with four Flanged Wheels and suspended by means of a ball-and-socket joint. The latter consists of an End Bearing 6 secured to a $1\frac{1}{2}$" Rod that is journalled in the $5\frac{1}{2}" \times \frac{1}{2}"$ Double Angle Strip 7 and also in a Double Bent Strip. The Rod 5 must rotate freely in the collar of the End Bearing 6. The

set-screws inserted in the collar are therefore provided with nuts that are locked against the sides of the collar to prevent the shanks of the screws touching the Rod 5. The latter is held in place in the Swivel Bearing by means of an ordinary collar and set screw.

The upper end of the pendulum carries another End Bearing 9 that is free to turn about a Pivot Bolt, the shank of which is gripped in the boss of an Eye Piece (new-style). The set-screws in this End Bearing should be locked in a similar manner to those of the Bearing 6 so that their shanks do not grip the Pivot Bolt. Two Washers are placed between the Swivel Bearing 9 and the boss of the Eye Piece. If an old-style Eye Piece is used at this point, the Pivot Bolt must be secured to it by means of two nuts, and the collar of the End Bearing 9 should be held in the required position on the shank of the bolt by means of additional Washers.

The Eye Piece slides on a $2\frac{1}{2}$" large radius Curved Strip 8, which is rigidly attached to the Face Plate 3 by means of two $\frac{1}{2}$" × $\frac{1}{2}$" Angle Brackets. The Brackets are secured to the Face Plate by $\frac{3}{8}$" Bolts, and three Washers must be placed on each bolt for spacing purposes.

The Crank 10 is mounted on a spindle that in practice operates the throttle valve. It is connected to the 2" Rod carrying the Bevel 4 by means of another 2" Rod 11. The latter is attached pivotally to the Crank by means of a Small Fork Piece and its other end is attached to the 2" Rod of the Bevel 4 by a Swivel Bearing, the set-screws of which are provided with nuts so that its collar is perfectly free to turn about the 2" Rod between two Collars and set-screws. The movement of the Crank 10 is limited by stops in the form of two $\frac{3}{4}$" Bolts secured to each end of a $1\frac{1}{2}$" Strip, and another Crank secured to its spindle carries a balance weight or counterpoise consisting of a 1" Pulley Wheel bolted to a 3" Strip.

A detailed description of the operation of the governor and the principles involved would necessarily be very lengthy. We must content ourselves therefore with a brief summary of the action of the model.

A certain amount of energy is required to maintain the pendulum 5 at a constant angle with the vertical, and it is a part of the contrivance artificially to increase the friction opposing the motion of the pendulum so that the pressure exerted by the counterpoise forms an actual measure of the maintaining force. Since the three Bevel Wheels form an epicyclic train, either the Bevel 2 and the lower Bevel fixed to the Rod of the Face Plate 3 must turn at the same rate, or Bevel 4 must run round the teeth of the lower Bevel. The latter is connected to the pendulum 5 and its rotation cannot be maintained without a constant expenditure of energy. Therefore the tendency of the lower Bevel is to lag behind the Bevel 2 and cause the Bevel 4 to travel round its teeth. But this movement of the Bevel 4 is checked by the counterpoise.

The governor is brought into action when the velocity of the engine is sufficient to keep the counterpoise raised slightly.

Because the lower Bevel is connected to a heavy revolving mass it can only change its velocity gradually, but the counterpoise is in equilibrium. Hence the slightest increase in velocity of Bevel 2 will be sufficient to raise the counterpoise further and so vary the steam valve opening.

(121)—Intermittent Switch

The device shown in Fig. 121 will start and stop an Electric Motor at certain prearranged intervals. It should be of great value for window display models, or it may be incorporated in the circuit operating a Hornby Electric Railway, and the trains thereby started and stopped automatically at the stations.

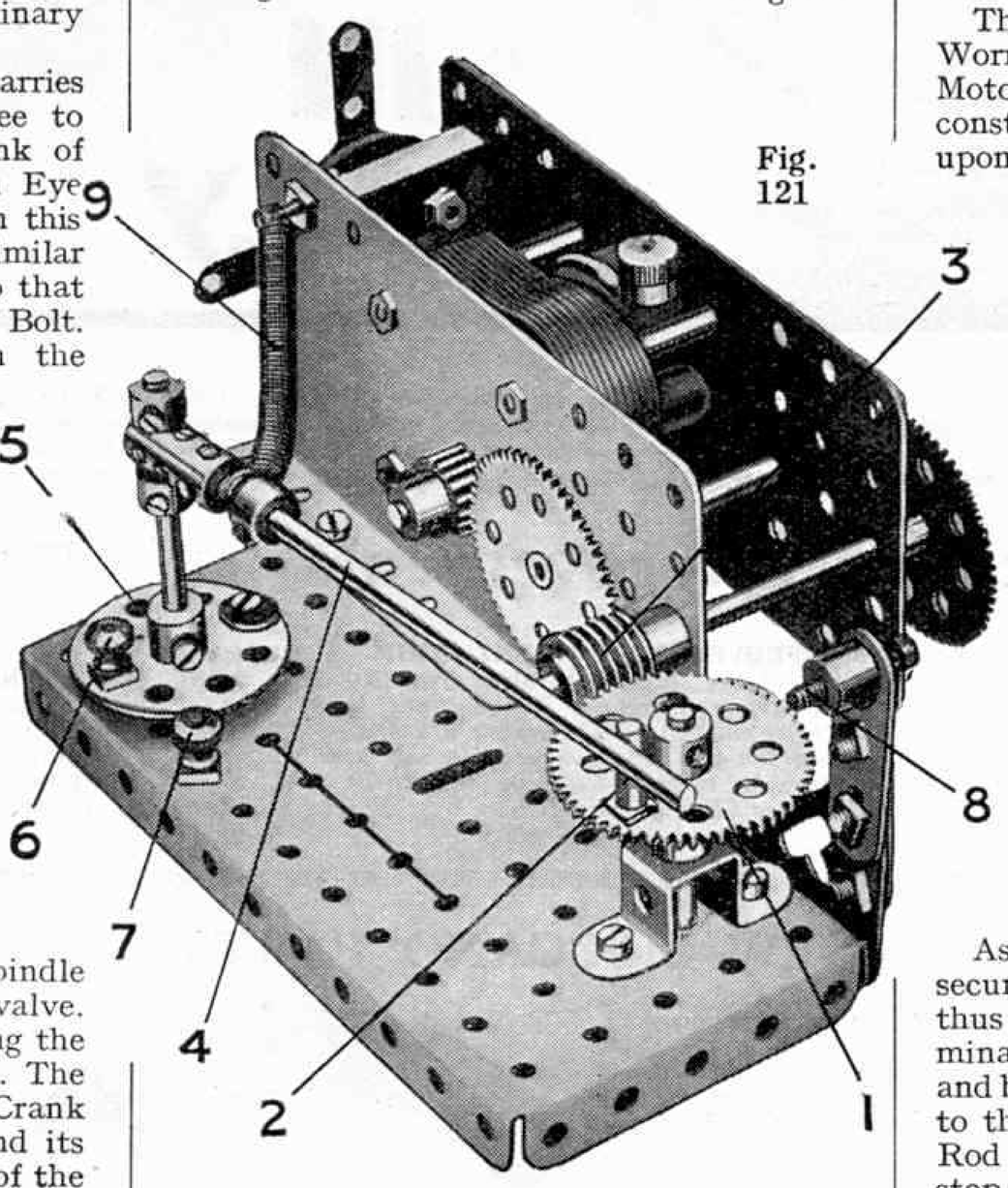


Fig. 121

The 57-teeth Gear 1 meshes with a Worm 3 that is driven from the Electric Motor via a suitable gear train. The constitution of the train depends entirely upon the results desired, since the periods of rest and motion are varied according to the rotational speed of the Gear 1. The $4\frac{1}{2}$" Rod 4 is mounted pivotally on a 2" Rod secured in the Bush Wheel 5, which is insulated from the base Plate by means of Insulating Bushes and Washers placed on the 6 B.A. Bolts that hold it in position. The terminal 6 is mounted on the shank of one of these bolts.

The contact piece consists of a $\frac{3}{4}$" Bolt 8 mounted in a Threaded Crank. The latter is secured to a Corner Bracket that is insulated from the base Plate by means of 6 B.A. Bolts and Insulating Washers and Bushes. Normally the Rod 4 is held against the Bolt 8 by a tension Spring 9, which is anchored to the side plate of the Motor by an insulated 6 B.A. Bolt.

As the Gear 1 rotates, the Threaded Pin 2 secured in its face presses against the Rod 4, thus allowing current to flow from the terminal 6 along Rod 4, through the Gear 1, and back through the frame of the apparatus to the uninsulated terminal 7. When the Rod 4 comes to rest against the insulated stop 8, contact between the Rod and the Pin 2 is broken until the Pin, in moving round, again touches the Rod.

(122)—Meccano Spherometer

(G. A. Geach, Bridlington)

The Meccano Spherometer illustrated in Fig. 122 may be used for practical purposes. A spherometer is an instrument specially designed for ascertaining the degree of accuracy of curved surfaces. It can also be used as an ordinary micrometer for measuring plain surfaces.

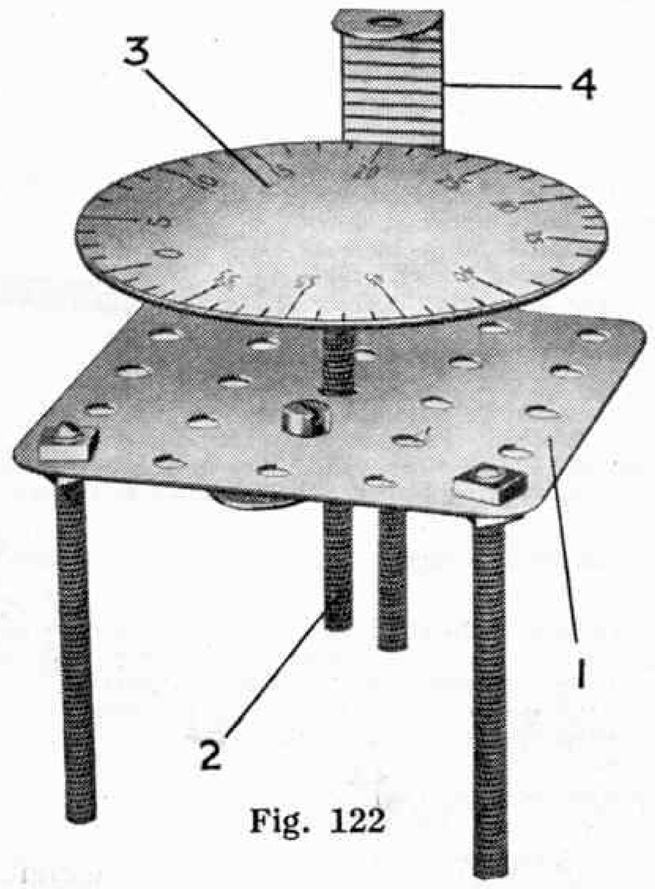


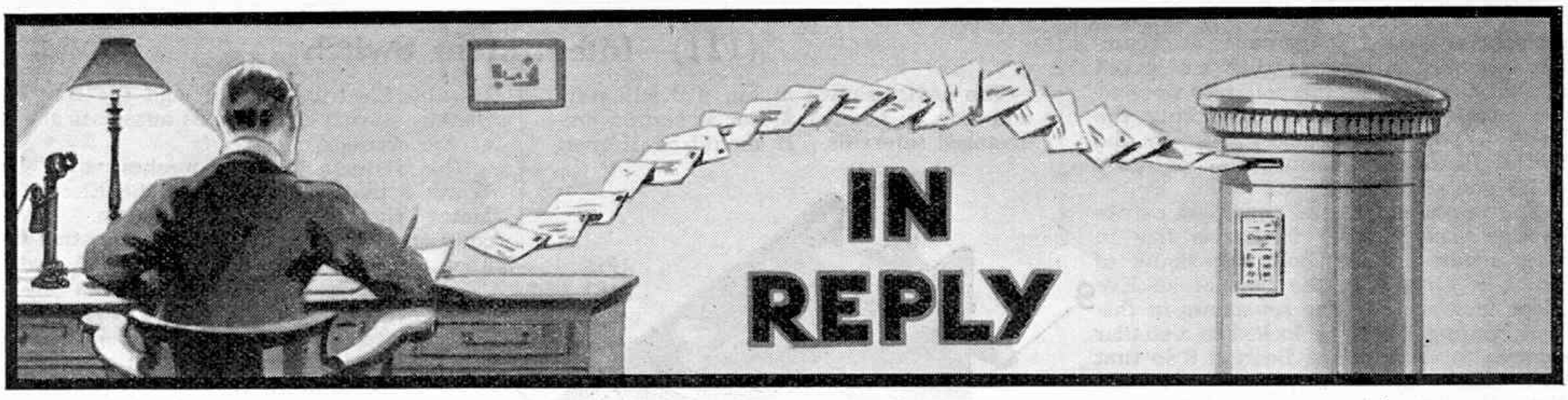
Fig. 122

The model consists of a $2\frac{1}{2}$" × $\frac{1}{2}$" Flat Plate 1 supported on three legs composed of 2" Threaded Rods. Another 2" Threaded Rod 2 inserted in the tapped bore of a Threaded Crank carries on its upper end a Face Plate on which is stuck a circular disc of white cardboard 3. A $1\frac{1}{2}$" × $\frac{1}{2}$" Double Angle Strip 4 is bolted to the Flat Plate 1 close to the edge of the dial 3 and a strip of cardboard is pasted to it.

The instrument is calibrated as follows. Place a sheet of glass or other perfectly smooth surface beneath the instrument and rotate the Threaded Rod 2 so that it descends in the boss of the Threaded Crank until it lightly touches the glass. Draw a line on the vertical scale 4 on a level with the dial 3, and indicate the point on the edge of the dial 3 nearest to the scale 4. Now give the dial 3 one complete turn and draw another line on the vertical scale 4 level with its edge. On measuring the portion marked off on the vertical scale it will be found to be exactly 1/32", for the pitch of the Meccano Threaded Rod is 32 to the inch. The process should be repeated until the scale 4 is completed.

Next the dial 3 must be divided into sixty equal divisions. If the dial 3 is moved through one of these divisions, the Rod 2 will rise or descend through a sixtieth part of 1/32", i.e. 1/1920th of an inch.

When using the instrument, the article to be measured is placed beneath the Rod 2 and the dial rotated until the end of the Rod just touches the object that it is required to measure. The readings of the vertical scale 4 in 32nds and that of the dial 3 in 1920ths of an inch are then added together to obtain the desired measurements.



In these columns we reply to suggestions regarding improvements or additions to the Meccano and Hornby Train systems. We receive many hundreds of such suggestions every week, and consequently we are able to publish only ideas that show particular interest or ingenuity. Suggestions submitted for consideration in this section must be written on separate sheets of paper and the name and address of the sender must appear on each sheet used. Envelopes should be addressed to "Suggestions," Meccano Ltd., Binns Road, Liverpool.

Suggested Meccano Improvements

IMPROVED COLLAR.—It would certainly improve the adaptability of the Collar if two additional holes were tapped in it. We will make special note of your idea. At the same time we would point out that the "spider" used in the Universal Coupling, Swivel Bearing, etc., has four holes tapped in its sides. (*Reply to W. C. Whitelow, Leeds*).

IMPROVED SINGLE BENT STRIP.—The adaptability of the single bent strip (part No. 102) would certainly be increased if the "one hole" portion were lengthened thus allowing a Collar to fit in between the two side pieces. We will bear your suggestion in mind. (*Reply to W. R. A. Hill, North Auckland, New Zealand*).

IMPROVED FACE PLATE.—We note your suggestion that the 3" diam. Face Plate should have more holes cut in it. This is a good idea and will be considered later. (*Reply to J. S. Holl, Southampton*).

IMPROVED CLOCKWORK MOTOR.—If the existing Clockwork Motor were fitted with a triple spring smoother running would no doubt be obtained. The cost, however, of fitting three springs prohibits us from making this addition. (*Reply to F. Purvez, Toronto*).

IMPROVED PAWL.—Your idea that the existing Pawl should have a threaded hole tapped in it is quite good. This hole would no doubt increase the adaptability of the part and your idea will receive further consideration. (*Reply to R. Wharry, Epsom*).

12½" × 12½" FLAT PLATE.—We are unable to consider your idea as few uses could be found for such a part. (*Reply to A. Bashan, Bassaleg*).

SMALL TENSION SPRINGS.—We do not consider there is any necessity for the manufacture of small tension springs for use in internal-expanding brakes as Spring Cord should serve the purpose quite well. (*Reply to Eric Backster, Huddersfield*).

NEW SPANNER.—Your suggestion that a Spanner having a box portion fitted to one end, should be manufactured, is quite good and will receive further consideration. (*Reply to L. J. Markham, Bristol*).

EXTENSION OF BOSSES.—To extend the bosses of the existing Gear Wheels and Pinions would no doubt give a firmer grip on the Rods, but the resulting Wheels would be rather clumsy. (*Reply to J. Tumelty, Manchester*).

TIE RODS.—We were interested in your idea that Rods having a flattened and drilled portion at each end should be made. We will file your idea for reference in the future. (*Reply to C. Jackson, Dalkey, Co. Durham*).

DISC WHEELS.—If we manufactured the 3" Pulley Wheel with only two holes in its face it could be used in very few models and we do not therefore think it would be advisable to make this change. (*Reply to F. Allaby, Newport*).

LONGER BOLTS.—The standard Bolt (part No. 37b) has been purposely shortened so as to give a neater appearance to models. Where a longer Bolt is required the ⅜" Bolt (part No. 111c) can, of course, be used. (*Reply to G. P. Shears, Herne Bay, and M. D. Reid, Hanstanton*).

NEW LEAFLETS.—During the present year we hope to bring out several new leaflets describing the more difficult Meccano models shown in the Manual. (*Reply to G. Herrell, Brixton*).

2½" BEVELS.—We do not see that 2½" Bevels would have many uses. They would moreover, be very costly to manufacture. (*Reply to E. E. Jones, Northwich*).

TELESCOPIC MASTS.—Telescopic masts are hardly suitable for incorporation in the Meccano system. Apart from their use in models of ships, they could be applied to very few models. (*Reply to Eric Holmes, Egham*).

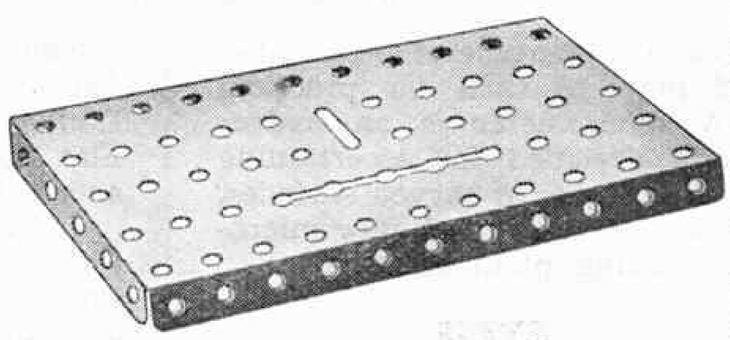
NEW MECCANO PARTS

No. 89a, 3" Curved Strip, cranked, 1¾" radius, four to circle. This new part will prove very useful in building flywheels, arches and other curved structures. Price 2d. each.



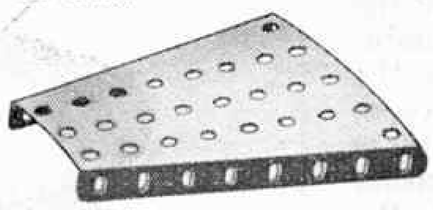
No. 155, Small Rubber Ring, diameter ⅝" (approx.). Designed primarily for use in frictional driving mechanism and to provide the necessary frictional surface in Meccano clutches, etc. It may also be fitted to a 1" Pulley Wheel and used as a rubber tyre in model motor cars. Price 1d. each.

IMPROVED MECCANO PARTS



No. 52, Perforated Flanged Plate, 5½" × 2½". This part is now available with flanges at each end as well as along the sides. The additional flanges will increase the adaptability of the Plate and will economise in the use of parts. Also, in addition to the usual perforations, the new Plate has a slot 2" long to receive the blade of the Circular Saw when the latter is mounted beneath the Plate, and a ⅝" × 3/16" hole near its centre. The purpose of the hole is to facilitate the adjustment of the saw guide piece. Price 5d. each.

No. 54, Perforated Flanged Sector Plate. The improved Sector Plate is provided with three parallel rows of holes punched down its centre. The additional holes increase the adaptability of the part to a considerable extent. Price 3d. each.



ALTERATIONS

Meccano boys are requested to note the following alterations in the names of two Meccano Parts recently introduced :—

Part No. 62b, Crank with Centre Boss, will be known in future as Double Arm Crank.
Part No. 120b, Spring for Spring Buffer, will be known as Compression Spring.

LARGER TRIANGULAR PLATES.—We note your suggestion that a Triangular Plate, size 3½" × 3½" should be introduced to the Meccano System. This would no doubt be useful in certain models and we will keep your idea before us. (*Reply to E. Moffatt, Penrith*).

POINTED STRIPS.—Your suggestion that a pointed strip should be manufactured is interesting. Apparently you intend this part to be used as a pointer. We would, however, mention that the Pointer (part No. 156) is specially designed for this purpose. (*Reply to P. C. Peppietta, Birmingham*).

TRIANGULAR BRACKETS.—A right-angled triangular bracket would have few uses in Meccano as such an accessory can easily be built up from existing parts. (*Reply to J. Longridge, Mobberley*).

OIL CANS.—Oil cans specially manufactured for Meccano enthusiasts will shortly be available. (*Reply to Basil Smith, Oxford*).

NEW SLEEVE PIECE.—Your suggested Sleeve Piece of such a size that it would fit over the bosses of two Pinions is quite interesting. Its use would be very restricted, however, and we do not therefore consider its manufacture advisable. (*Reply to R. Wherry, Epsom*).

SPRINGS FOR MOTOR.—If we introduced special spring units for building up clockwork motors, keyed rods would have to be manufactured. We cannot for this reason give any further thought to your idea at the present. (*Reply to B. Tucker, Carina, Queensland*).

LONGER RACK STRIPS.—We do not see that any advantage would result from the introduction of longer Rack Strips. Where the existing Rack Strip proves too short two or more may easily be fastened together to obtain the required length. (*Reply to N. H. Smith, Bloxham*).

SLOTTED NUTS.—We were particularly interested in your suggestion that slotted nuts should be manufactured and will keep your idea before us. (*Reply to K. Wilton, Enfield*).

HELICAL GEARS.—Although helical gears would give smoother motion, the cost of manufacture of this type of gear wheel prohibits its introduction. (*Reply to J. K. Kennett, Peterborough, and L. Foster, Leeds*).

LOCOMOTIVE WHEELS.—We are afraid that special wheels for locomotives are unsuitable additions to the system, as their uses would be very restricted. (*Reply to J. B. S. Edwards, Weymouth*).

WIRE STAYS.—We are at the present moment considering the introduction of wire stays. Meanwhile we would remind you that the Loom Healds can in certain cases be used quite effectively as strengthening stays. (*Reply to J. Morris, Bristol*).

BALL-AND-SOCKET JOINT.—A special ball-and-socket joint would have little use in the Meccano system, as its functions are already covered by the Universal Coupling. An interesting built-up ball-and-socket unit will be found in the Meccano model of Siemens' Chronometric Governor described on page 424 of this issue. (*Reply to H. Hauptman, Sydney, N.S.W.*).

LARGER CONTRATE WHEELS.—We were interested in your suggestion that 3 in. dia. Contrate Wheels should be introduced to the Meccano System. We are afraid, however, that little use could be found for such wheels and we cannot therefore consider their introduction. (*Reply to D. Weston, Muswell Hill, London, N.10*).

Suggested Hornby Train Improvements

DISC INDICATORS.—Disc indicators are by no means universally used in actual railway practice and so we do not think it would be worth while introducing them for use on our trains. (*Reply to D. A. Heaps, Hastings*).

GRADIENT POSTS.—As we have stated before in these pages, gradient posts will be available before long. Look out for a further announcement. (*Reply to Norman Gernat, Leigh-on-Sea*).

SIX-WHEELED WAGON.—You are correct in assuming that a Hornby six-wheeled wagon is not yet available. We agree that this would be quite a novel type and it will have full consideration when we make our next addition to our goods rolling stock. (*Reply to Bernard Graves, Taunton*).

FRENCH GOODS TRAIN.—We do not think it would be advisable to sell French goods trains already boxed in sets. The component parts can be purchased separately. (*Reply to Jack Stanbridge, Perth, W.A.*).

CURVES FOR DOUBLE TRACK.—We are at present experimenting with double track and we hope to make an interesting announcement before long. (*Reply to D. G. Whitaker, Bradford*).

SMALLER HEAD LAMPS. — We do not consider that there would be any advantage in making the head lamps on our locomotives smaller and as a matter of fact you are the first reader who has made this suggestion. (*Reply to Gordon Judd, London, E.7*).

WIDER LEVEL CROSSINGS. — It would certainly be very useful to make the distance between the rails of the level crossing and the parallel points standard. We are giving this matter careful consideration. (*Reply to W. Lloyd-Jones, Derby*).

ELECTRIC TANK ENGINE.—We are keeping careful record of all those who desire No. 2 Locomotives fitted with electric mechanisms. (*Reply to J. W. Pickles, Bradford, and M. Mackirdy, Dumford*).

LOCOMOTIVE WHISTLES.—Locomotive whistles to be operated from the track would be very difficult to manufacture and we do not see any advantage to be gained by their introduction. (*Reply to H. Edwards, Swansea, and W. Sharp, Grimsby*).

EIGHT-COUPLED ENGINE.—We cannot possibly consider introducing an eight-coupled mechanism, as locomotives fitted with eight-coupled wheels would not negotiate 2 ft. radius curves. (*Reply to J. Dawson, Eaglescliffe, and L. Harris, Sutton*).

CAST WHEELS.—We are experimenting with coaches fitted with cast wheels and we hope to announce the results later. *Reply to J. M. Whitaker, Sunderland; J. Porter, N.W.3; and George Illingworth, Burton-on-Trent*).

3 ft. RADIUS RAILS.—We agree that curved rails to form a circle 6 ft. in diameter would be most useful to some enthusiasts. The objection to this idea, however, lies in the fact that comparatively few can afford to devote the space required by a layout in which rails of this diameter are used. (*Reply to B. Hart, Leith*).

SOMERSAULT SIGNAL.—It is very unlikely that this type of signal will come into general use on British railways and for this reason we do not think it would be advisable to make a special model of it. (*Reply to A. Munro, Oxford*).

REVISED COLOURING OF BREAKDOWN VAN.—We understand why you make your suggestion but we think that to paint the breakdown van grey all over would greatly detract from its appearance and in consequence decrease its popularity. (*Reply to Wylie, Edinburgh*).

00 GAUGE RAILWAY.—For the time being at any rate we do not propose to introduce 00 gauge trains. (*Reply to G. E. Mellor, Rhos-on-Sea*).

ETHYL PETROL TANK.—Although we are quite aware that "Ethyl has come," we do not propose to manufacture petrol wagons for her yet! (*Reply to Dario Tesora, Musselburgh*).

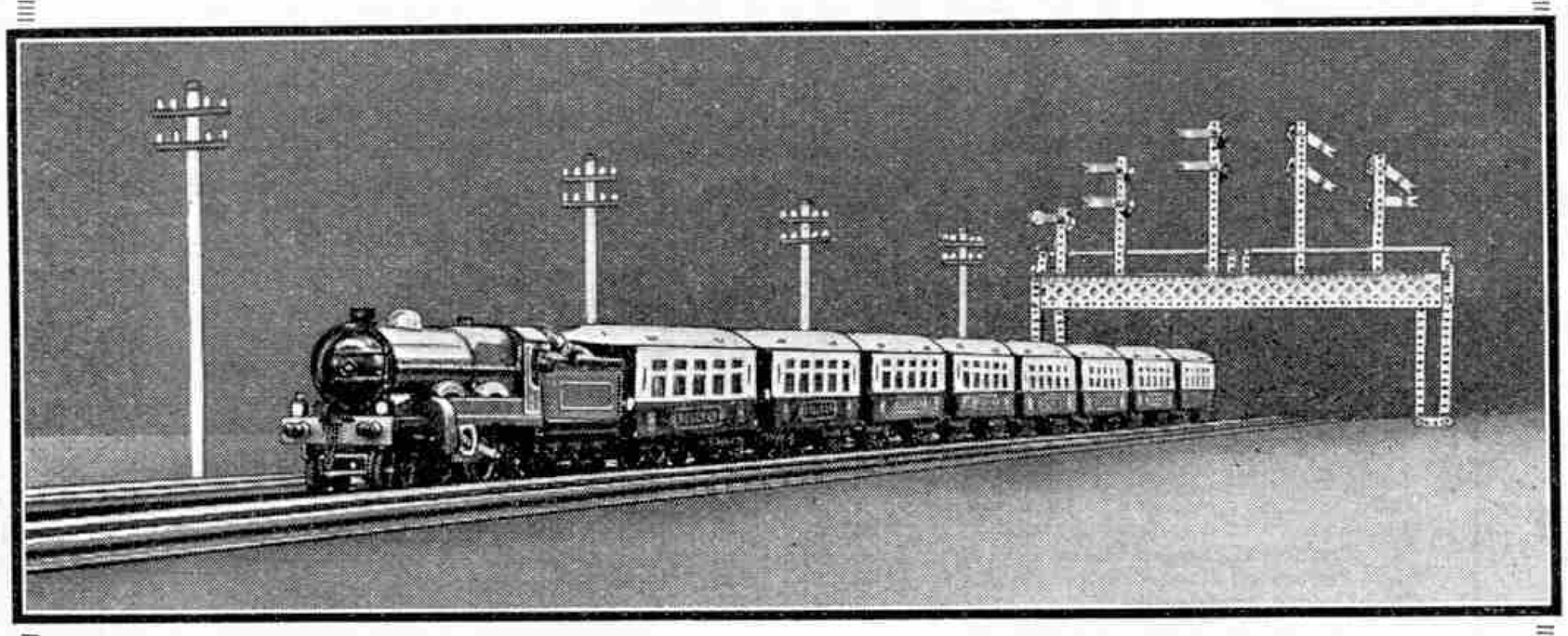
BRASS SAFETY VALVES FOR G.W.R.—You will be pleased to hear that in future the Great Western safety valves will all be made of polished brass and will not be coloured black as hitherto. (*Reply to R. Victor Wheeler, Enfield*).

COAL STACKS.—Model coal stacks would undoubtedly add greatly to the appearance of miniature sidings, especially if placed close to engine sheds. We shall give your idea careful consideration but in the meantime we suggest that it would not be difficult to make this type of accessory for yourself. (*Reply to R. Johnston, Loughborough*).

DYNAMOS FOR COACHES. — It would be impossible to fit working dynamos to Hornby coaches. Dummy dynamos might be fitted, but we do not think they would be received with any great enthusiasm. In any case it would be utterly impossible to run an electric locomotive from current generated by a dynamo in one of the train coaches. (*Reply to Roy Bolitho, Transvaal, S.A.*).

COW CATCHERS FOR LOCOMOTIVES. — As cow catchers are not seen at all on English railways we do not think it advisable to fit them to our locomotives. (*Reply to W. Dunsdon, Cape Town, S.A.*).

A REALISTIC HORNBY TRAIN PHOTOGRAPH



Down "Harrogate and Edinburgh Pullman" approaching Harrogate, drawn by Hornby Two-Cylinder 4–4–2 Locomotive

This photograph of a Hornby Pullman express is a typical example of the realistic effect that may easily be obtained in miniature railway photography provided that the necessary small amount of care is taken. One of the most important points is that the lens of the camera should not be much more than 1½ in. above the actual running rail surface in order to obtain the effect of a real express approaching the photographer. Another point is that great care should be taken to ensure that the coach roofs and the wheels are in alignment, which means that the track must be absolutely level to commence with. Finally, any signals, telegraph poles or other accessories that are to be included in the picture should be placed accurately and not just dumped down anywhere. In order to obtain the maximum amount of detail a full exposure should be given, and it should be remembered that here, as in most classes of photography, a considerable amount of over-exposure is far less harmful than a small amount of under-exposure.

TRAINS IN OLD COLOURS.—We agree that there would be a certain amount of interest in trains bearing the colours of the old pre-group companies. At the same time we are afraid that the majority of Hornby railway enthusiasts would think we were horribly behind the times if we were to revert to such colouring! (*Reply to B. W. Barwise, Birmingham*).

DESTINATION BOARDS.—Destination Boards would no doubt give the "finishing touch" to the No. 3 Hornby expresses. There are certain difficulties attached to their introduction, but we shall give the matter careful consideration. (*Reply to D. Goodman, Cardiff*).

STEAM LOCOMOTIVES.—We have no intention at present of introducing steam locomotives. These have strong claims to attention, of course, but from the point of view of running a really railway-like layout, and in particular if timetable working is to be carried on, clockwork locomotives are far more convenient. (*Reply to J. Morris, Bury, and W. Close, Diss, Norfolk*).

GARRATT TYPE LOCOMOTIVE.—This type of locomotive would be very costly to manufacture and would not prove very popular as it is quite uncommon. (*Reply to F. Holt, Wolverhampton, and I.M.U. Gallaway, Edinburgh*).

TWO-SPEED GEAR.—We have received many suggestions regarding the introduction of a two-speed gear to our locomotives. We agree that such a gear has many advantages and the idea will be considered. The first difficulty, of course, is that such an innovation would involve the entire reconstruction of the existing mechanisms which would be a very serious matter. (*Reply to V. Potten, Manchester*).

THREE-WAY POINTS.—These would be very complicated and most difficult to manufacture. The cost of them would be far too high to justify our producing them. (*Reply to M. Falconer, Worcester*).

OUTSIDE LIVE RAIL.—We consider that the centre live rail system for electric trains is by far the simplest, and so we do not propose to adopt your suggestion for manufacturing track with outside feeder rails. (*Reply to S. Brotherton, Beckenham*).

LUMINOUS PAINT ON LAMPS.—There would be very little advantage to be gained by painting the lamps of Hornby engines with luminous paint, for the simple reason that this would only be seen to advantage in the dark. (*Reply to L. Worts, Leicester*).

SLIP COACHES.—We have been experimenting with slip coaches and we hope to make an announcement regarding them before long. (*Reply to Cubben, Brighton*).

SIGNALS AND POINTS CO-OPERATED.—It should not be difficult for a Hornby enthuiast who desires to work both signals and points from the same levers to devise a means of connecting them together. (*Reply to B. Snell, Axminster*).

VACUUM BRAKE.—Although it would be impossible to fit working vacuum brakes to our rolling stock, vacuum brake pipes would certainly adorn the end of the coaches and so we will consider their introduction. (*Reply to C. H. Mellor, Fairlie, Ayrshire*).

STANDARD L.N.E.R. LETTERING ON GOODS WAGONS.—Goods stock bearing the initials "N.E." have now been in production for some time. (*Reply to J. Jones, Manchester*).

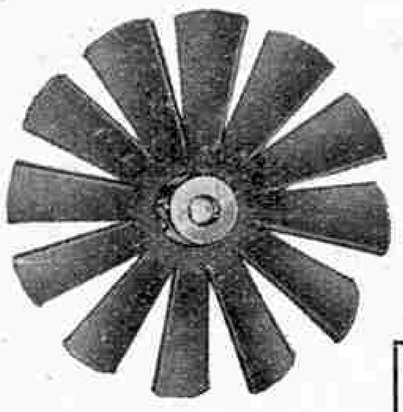
DIAGONAL WHITE LINE ON GOODS WAGONS.—There would not be much advantage to be gained by painting a diagonal white line on some of our L.M.S. wagons. The object of these lines in actual railway practice is merely to distinguish specially constructed wagons. (*Reply to R. N. Walker, Liverpool*).

HORSE BOX.—We agree that a Horse Box would be of great interest on any model railway. We are giving this matter our consideration as stated previously. (*Reply to Richard Wilson, Hale, Cheshire*).

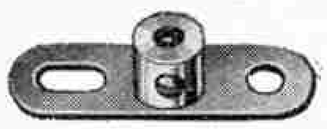
MODEL OF "KING GEORGE V."—Our present No. 2 Locomotive is quite a good model of the "George V" Class engines on the L.M.S. If it is the Great Western Railway "*King George V*" that you have in mind, we are afraid we cannot adapt your idea at present, as it entails the use of a six-coupled mechanism. (*Reply to A. Smith, Maidenhead*).

AMERICAN TRAIN SET.—At present we have no intention of manufacturing an American train set as we do not consider that it would be sufficiently popular to justify its cost. (*Reply to Murgatroud, Bradford*).

LOWER BUFFER BEAMS.—We are interested in your suggestion that Hornby Buffer Beams should be brought lower. Although an alteration of this kind entails the revision of the whole of the present rolling stock this would certainly be greatly improved in appearance, and so we will give your idea careful attention. (*Reply to J. J. Johnston, Aberdeen*).



No. 157



No. 62B



No. 138A



No. 150



No. 142A

MECCANO ACCESSORY PARTS

New parts are constantly being added to the Meccano system and it is interesting to note that the range now consists of a total of 246. All these parts function in exactly the same manner as the corresponding elements in actual practice.

A selection of the splendid parts that have recently been introduced is illustrated on this page. Every Meccano boy should make a point of adding these parts to his equipment, for they make possible a wide range of interesting and realistic movements.

The attention of Meccano users is drawn to the new style Flanged Plate, Part No. 52 (with flanges at the ends as well as the sides) and to the improved Sector Plate, Part No. 54 (with two additional rows of holes). The revision in the designs of these plates makes them more adaptable and gives them wider scope.

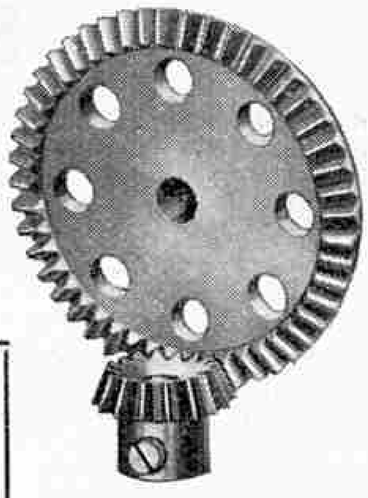
New Meccano Parts

No.			s.	d.
20b.	Flanged Wheels, ¾" diam.	each	0	4
25a.	Pinion Wheels, ¼" diam., double width face ...	„	0	8
26a.	„ „ ½" diam., double width face ...	„	0	6
30a.	Bevel Gears, ½", 16 teeth } *Can only be*	„	0	6
30c.	„ „ 1½", 48 „ } *used together*	„	1	6
50a.	Eye Pieces, with boss	„	0	4
52.	Perforated Flanged Plates, 5½" × 2½"	„	0	5
54.	Perforated Flanged Sector Plates	„	0	3
62b.	Double Arm Cranks	„	0	3
89a.	3" Curved Strips, cranked, 1¼" radius, 4 to circle	„	0	2
116a.	Fork Pieces, Small	„	0	3
138a.	Ship's Funnels, Cunard type ...	„	0	9
142.	Rubber Rings, 3" rim	„	0	3
142a.	Dunlop Tyre to fit 2" diam. rim...	„	0	4
142b.	„ „ „ 3" „ ...	„	0	6
150.	Crane Grabs	„	0	7

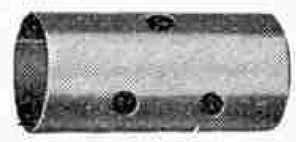
No.			s.	d.
151.	Pulley Blocks, Single Sheave ...	each	0	8
152.	„ „ Two „ ...	„	0	9
153.	„ „ Three „ ...	„	1	0
*154a.	Corner Angle Brackets, ½", right hand	½ doz.	0	6
*154b.	Corner Angle Brackets, ½", left hand	„	0	6
155.	Rubber Rings, ⅜"	each	0	1
156.	Pointers, 2½" over all, with boss...	„	0	4
157.	Fans, 2" diam.	„	0	4
158a.	Signal Arms, Home	„	0	5
158b.	„ „ Distant	„	0	5
*159.	Circular Saws	„	1	0
162.	Boiler, complete with ends	„	1	0
162a.	Boiler ends	„	0	3
163.	Sleeve Pieces	pair	0	6
164.	Chimney Adaptors	each	0	2
165.	Swivel Bearings	„	0	6
166.	End „	„	0	3

IMPORTANT.—Meccano Accessory Parts will be supplied in colours unless nickelled parts are specially ordered.
**These parts are available with nickel finish only.*

Ask your dealer for an illustrated price list



Nos. 30A and 30c



No. 163

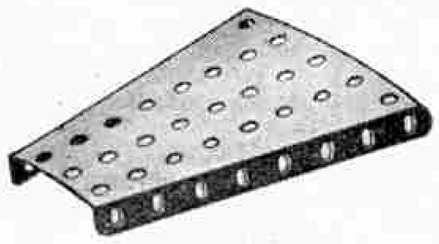


No. 151

No. 152



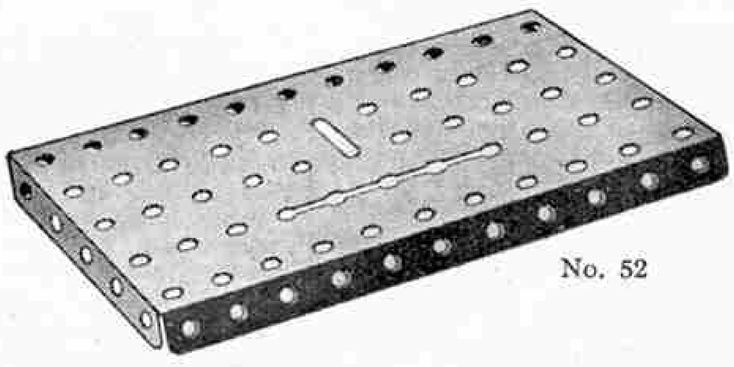
No. 153



No. 54



No. 164



No. 52



Nos. 154A and 154B



No. 25A



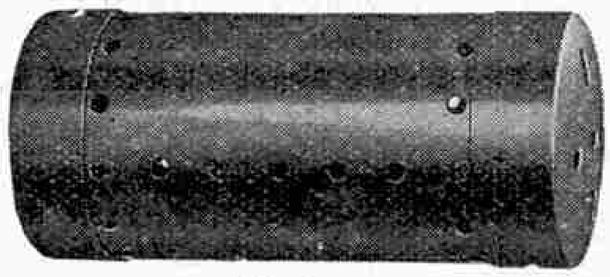
No. 20B



No. 165



No. 156



No. 162



No. 166



No. 116A



No. 159



No. 158A

MECCANO LIMITED, Binns Road, LIVERPOOL

Electricity Applied to Meccano

VII.—An Electric Locomotive and Overhead Wire Transmission

These articles are intended to draw every Meccano boy's attention to the numerous fascinating uses to which the Meccano electrical parts may be put. The first two articles of the series dealt with the elementary principles of electricity, and subsequent articles described various Meccano switches, a coil-winding machine, a Meccano electric telegraph system, electro-magnets, a galvanometer, electric motors, and other simple apparatus. This month we are able to publish particulars of a very efficient and easily-built electric locomotive, and of three different types of overhead wire standards. All these models are constructed rom a few ordinary Meccano parts used in conjunction with the special electrical accessories.

FOR more than a century steam has reigned supreme as the chief method of propulsion on railways.

To-day, however, its supremacy is challenged seriously by its rival electricity. The use of electricity as the prime mover on railways has several distinct advantages over that of steam. The one that most concerns the general public—but not necessarily Meccano boys!—is cleanliness; railway stations and rolling stock can be kept much cleaner when freed from the smoke emitted by steam locomotives. This point alone means a considerable saving in railway operating expenses.

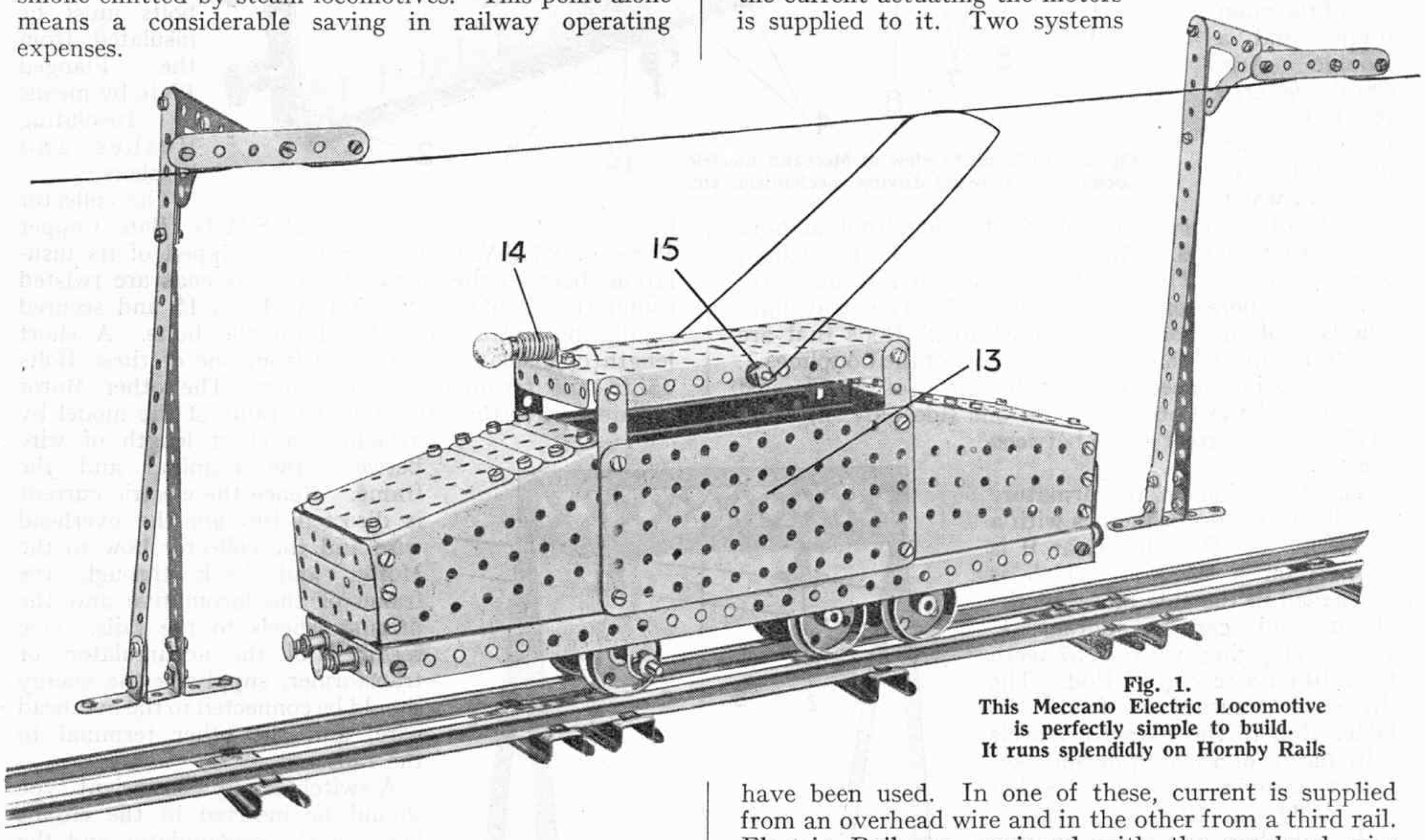


Fig. 1.
This Meccano Electric Locomotive is perfectly simple to build. It runs splendidly on Hornby Rails

Another very important consideration lies in the fact that electric trains are capable of much quicker acceleration. This is a great advantage for heavy suburban trains that are required to stop at several stations situated at comparatively short distances apart. The Southern Railway Company has fully realised these advantages, and it now owns 800 miles of electrically-equipped track, forming the largest suburban electric system in the world.

On the other hand, in the case of long distance trains that stop infrequently, the steam locomotive is likely to hold its own for a very long time to come. The electrification of the great main lines in this country would involve an enormous outlay of capital, for huge power stations would be required with substations for every few miles of track. In addition the change would necessitate the wholesale scrapping of the magnificent express locomotives now owned by our railway companies and the entire reorganisation of the numerous locomotive works.

The most interesting feature of an Electric Locomotive is the method by which the current actuating the motors is supplied to it. Two systems have been used. In one of these, current is supplied from an overhead wire and in the other from a third rail. Electric Railways equipped with the overhead wire system are not very common in this country. Only recently the overhead system on the central section of the Southern Railway was scrapped in favour of the third rail system. On the Continent and in America, however, the method of carrying the current through an overhead wire is regarded more favourably—and is still largely used.

Meccano Electric Locomotive

Our principal model this month is a simple electric locomotive built entirely from Meccano parts and driven by a 4-volt Meccano Electric Motor. It is designed to work on the overhead wire system, but if desired it can easily be converted for third rail working

by employing a Meccano Electric Collecting Shoe (part No. 149) in place of the overhead current collector. The locomotive is built to gauge 0 and will run splendidly on Hornby rails.

The construction of the model should be commenced by building the main frame. This consists of 12½" Angle Girders 1 (Fig. 2) spaced apart by 2½" × ½" Double Angle Strips 2. The 2½" × 1" Double Angle Strip 3, which is bolted to the Angle Girders 1 in the ninth holes from one end, forms the bearings for the 3½" Rod carrying the Flanged Wheels 4.

The 2½" Strip 5 is bolted in the eighth holes from the other end of the main frame, and a Double Arm Crank secured to it forms a reinforced bearing for the bogie pin, which consists of a short Rod held in the longitudinal bore of the Coupling 6. The two Couplings 7 are secured one on each end of a short Rod that is fixed in the centre transverse bore of the Coupling 6. The travelling wheels 8 of the bogie are secured to 2" Rods that are free to revolve in the transverse bores of the Couplings 7, Washers being placed between the bosses of the Flanged Wheels and the Couplings 7 on one side only, in order to obtain the correct gauge between the wheels.

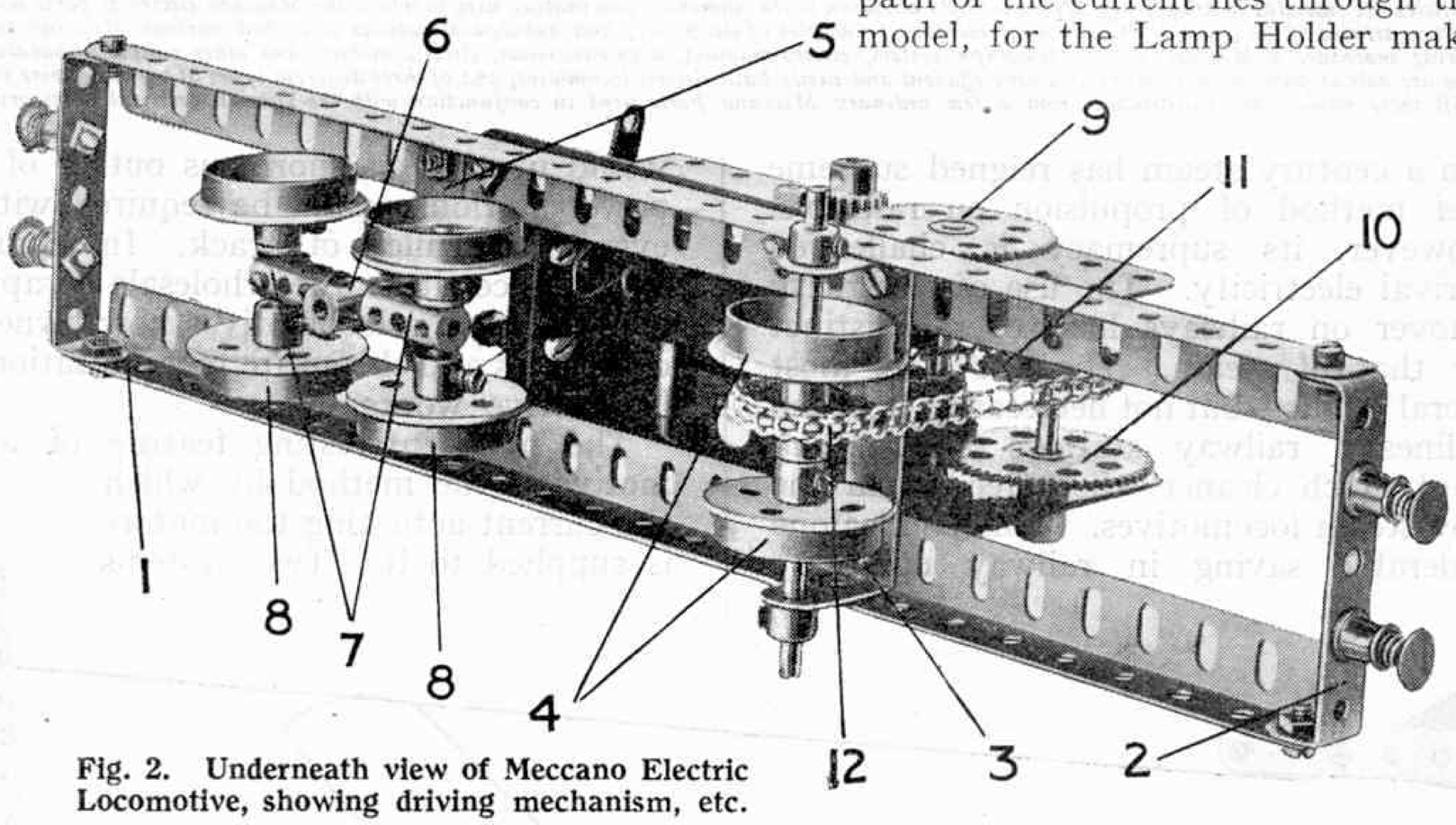


Fig. 2. Underneath view of Meccano Electric Locomotive, showing driving mechanism, etc.

The ½" Pinion on the armature spindle of the Motor meshes with a 57-teeth Gear 9. This Gear 9 is secured on a 2" Rod, which is journalled in the side plates of the Motor and carries another ½" Pinion engaging with a 57-teeth Gear 10 on a second 2" Rod. The drive is transmitted from the latter Rod to the Flanged Wheels 4 by means of a length of Sprocket Chain engaging the 1" Sprocket Wheels 11 and 12.

The body of the locomotive should be built separately from the main frame and machinery and afterwards attached to the frame by eight nuts and bolts. Its construction is indicated clearly in the illustration (Fig. 1) and therefore little comment is necessary. A point worth noticing, however, is the fact that the 5½" × 2½" Flat Plates 13 are spaced away from the side vertical 3½" Strips by two Washers placed on each of the retaining bolts. The object of this is to obtain the necessary clearance between the plates and the projecting ends of the armature spindle of the Motor.

The 6 B.A. Bolt securing the Lamp Holder 14 is passed through a ½" × ½" Angle Bracket that is bolted to the 5½" × 2½" Flanged Plate forming the roof of the locomotive, but it is insulated therefrom by means of an Insulating Bush placed on the shank of the bolt against the Bracket. The current is led to the lamp by means of a wire that is twisted round the shank of the 6 B.A. Bolt and securely gripped between the Insulating Bush and the nut that holds the bolt in position. The return path of the current lies through the frame of the model, for the Lamp Holder makes contact with the ½" × ½" Angle Bracket. The wire connected to the lamp is also connected to one of two 6 B.A. Bolts 15 secured one on each side of the roof of the locomotive. These bolts must be insulated from the Flanged Plate by means of Insulating Bushes and Washers.

The collector bow consists of a length of 22 S.W.G. Bare Copper Wire (or 23 S.W.G. Copper Wire stripped of its insulation) bent to the shape shown. Its ends are twisted round the shanks of the 6 B.A. Bolts 15 and secured rigidly by extra nuts placed on the bolts. A short length of insulated wire is led from one of these Bolts 15 to one terminal of the Motor. The other Motor terminal is earthed through the frame of the model by attaching a short length of wire between the terminal and the frame. Hence the electric current is directed through the overhead wire and the collector bow to the Motor, and back through the frame of the locomotive and the driving wheels to the rails. One terminal of the accumulator, or transformer, supplying the energy should be connected to the overhead wire, and the other terminal to the rails.

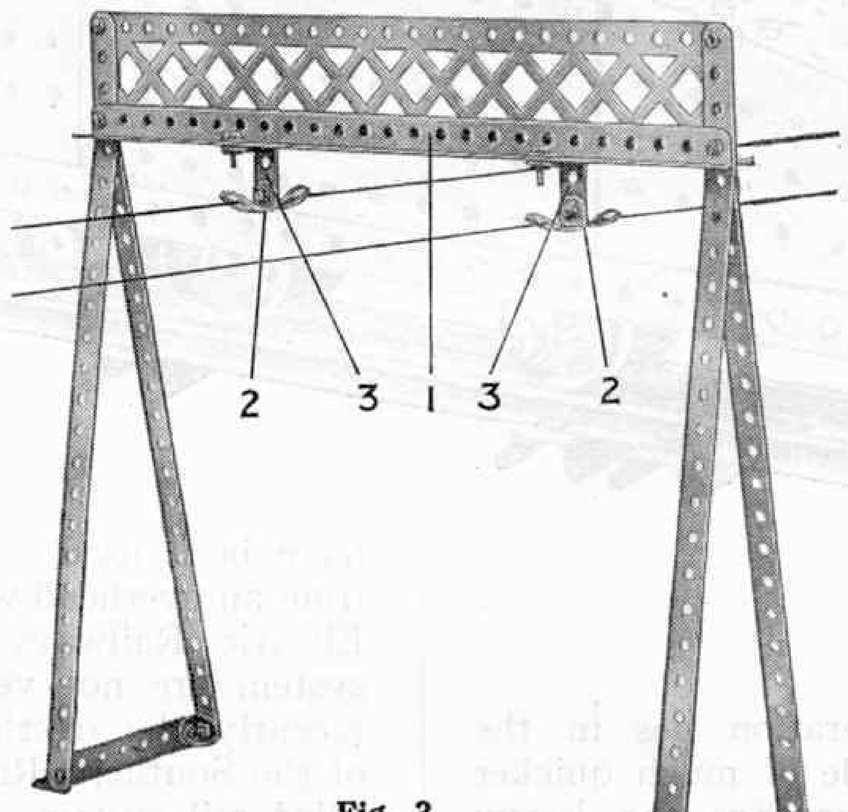


Fig. 3
Gantry for two Overhead Electric Wires

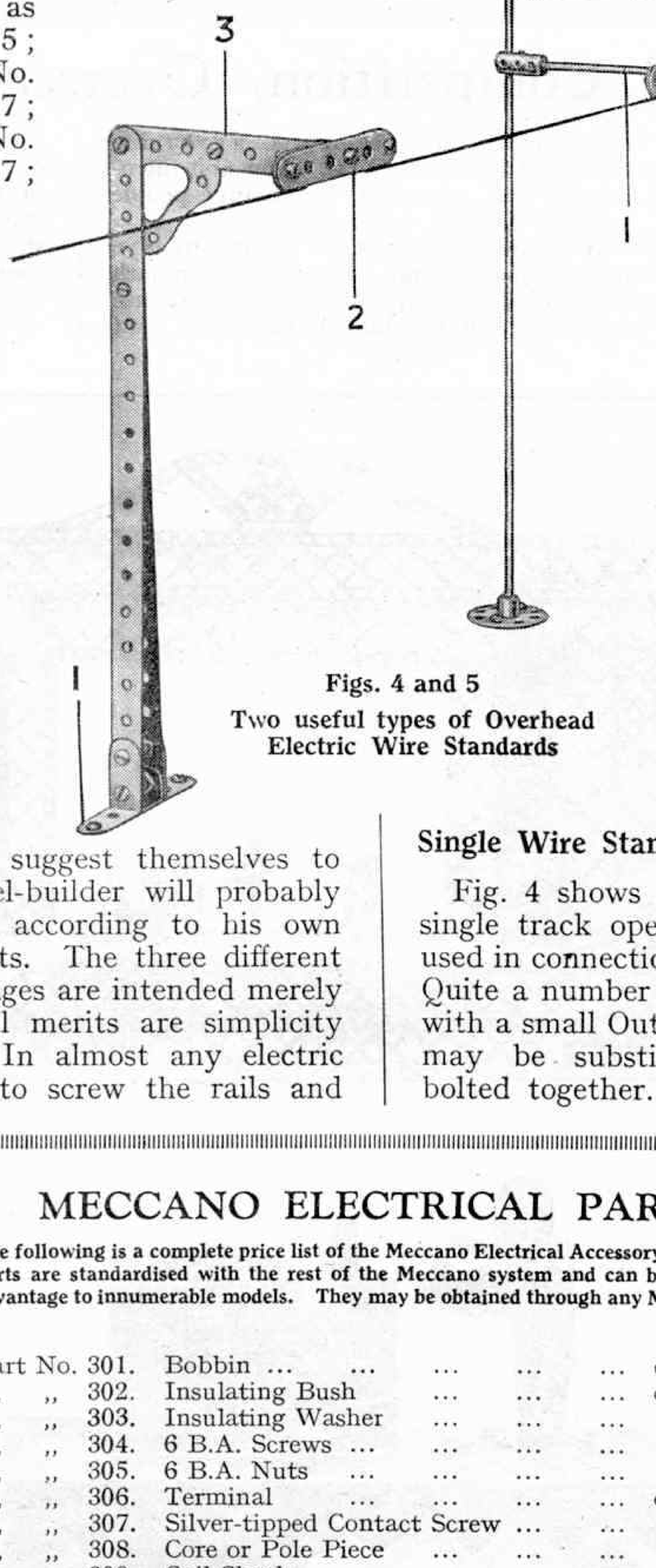
A switch of any convenient type should be inserted in the circuit between the accumulator and the rails or overhead wire so that the locomotive can be started or stopped at will. It will be remembered that several different types of switches were described in the third article of this series (see *"M.M."* for January, 1928). Much additional interest can be obtained if a Meccano Resistance Controller is also placed in the circuit, for the speed of the locomotive can then be varied as desired.

In order to obtain the best possible results from the model, the rails and flanges of the travelling wheels should be kept scrupulously clean, and the collector bow should be adjusted so that it presses firmly against

the overhead wire.

The best type of wire to use for the overhead conductor is 22 or 23 S.W.G. Copper Wire. If the latter type is used the cotton insulation must first be scraped away, of course. Where it is necessary to join the wire the two ends should be twisted together and clamped to one of the standards in the manner described below.

The parts required to build the Meccano electric locomotive are as follows: 4 of No. 3; 9 of No. 5; 2 of No. 8; 1 of No. 12; 1 of No. 16; 2 of No. 16a; 3 of No. 17; 1 of No. 18b; 6 of No. 20; 1 of No. 26; 2 of No. 27a; 63 of No. 37; 1 of No. 46; 6 of No. 48a; 1 of No. 52; 2 of No. 52a; 4 of No. 54; 9 of No. 59; 1 of No. 62b; 3 of No. 63; 2 of No. 72; 2 of No. 96; 4 of No. 120a; 3 of No. 302; 2 of No. 303; 3 of No. 304; 5 of No. 305; 1 of No. 310; 1 of No. 311; length of 22 or 23 Gauge Copper Wire (Parts Nos. 314 and 315); 4-volt Motor.



Figs. 4 and 5
Two useful types of Overhead Electric Wire Standards

Types of Overhead Wire Standards

An overhead wire that is required to convey current to a model electric train must be supported at numerous points along the track. No doubt an infinite variety of standards suitable for this purpose will suggest themselves to Meccano boys, and each model-builder will probably prefer to build the standards according to his own particular tastes or requirements. The three different standards illustrated in these pages are intended merely as suggestions. Their principal merits are simplicity of construction and rigidity. In almost any electric railway it is almost essential to screw the rails and standards to the floor or other wooden base and the standards illustrated are designed for this purpose.

The standard shown in Fig. 3 is of gantry form and is suited particularly for parallel track working. A number of standards should be constructed exactly as shown and fastened at intervals along the track. When so arranged they will enhance the appearance of any model railway layout to a very large extent.

Each side of the gantry consists of two 12½″ Strips attached by means of Angle Brackets to a base composed of a 3½″ Angle Girder. These 3½″ Girders should be secured to the wood base by ordinary screws. At the top the side members are connected together by a pair of 12½″ Angle Girders 1 and a 12½″ Braced Girder, which adds considerably to the finish of the model. Each of the two supports for the wires consists of two 1″×½″ Angle Brackets 2 bolted to a 1″×1″ Angle Bracket 3. The latter is secured to the Angle Girders 1 by means of 6 B.A. Bolts and insulated therefrom by Insulating Bushes and Washers. When the necessary standards have been erected the overhead wire may be fixed in position. The wire should be inserted in the elongated hole of one of the 1″×½″ Angle Brackets in each support, and led back through the round hole of the same Bracket. It is then led through the round hole of the second Angle Bracket and out through the elongated hole, and so on to the next standard.

The object of insulating the Angle Brackets 1 from the gantry is to minimise the possibility of short-circuiting. The 1″×½″ Angle Brackets should be bent slightly, as shown, so that the collector bow of the locomotive may slide over them without shock or risk of displacement.

The parts required to build this standard are: 4 of No. 1; 2 of No. 8; 2 of No. 9b; 4 of No. 12; 2 of No. 12a; 4 of No. 12b; 14 of No. 37; 1 of No. 99; 2 of No. 302; 2 of No. 303; 2 of No. 304; 2 of No. 305.

Single Wire Standard

Fig. 4 shows a simple type of standard suitable for single track operation. It is this type that is shown used in connection with the electric locomotive in Fig. 1. Quite a number of these standards could be made even with a small Outfit. If desired the 9½″ Strips illustrated may be substituted by 5½″ Strips overlapped and bolted together.

As will be seen, the 9½″ Strips are splayed out at the bottom by a Double Bracket, and two 1″×1″ Angle Brackets 1 are provided with which to secure the model to the floor or baseboard. The support for the electric conductor wire consists of two 3″ Strips 2 spaced apart at each end by a Flat Bracket. The Strips 2 are bolted to an Angle Bracket that is insulated from the top of the standard by means of a 6 B.A. Bolt and an Insulating Bush and Washer.

The overhead wire is led round the end of one of the Flat Brackets, between the 3″ Strips, over the shank of the bolt that secures the Strips to the Angle Bracket, and then round the lower edge of the other Flat Bracket.

(Continued on page 442

MECCANO ELECTRICAL PARTS

The following is a complete price list of the Meccano Electrical Accessory Parts. These parts are standardised with the rest of the Meccano system and can be adapted with advantage to innumerable models. They may be obtained through any Meccano dealer.

				s.	d.
Part No.	301.	Bobbin	each	0	4
,, ,,	302.	Insulating Bush	doz.	0	6
,, ,,	303.	Insulating Washer	,,	0	3
,, ,,	304.	6 B.A. Screws	,,	0	6
,, ,,	305.	6 B.A. Nuts	,,	0	3
,, ,,	306.	Terminal	each	0	1
,, ,,	307.	Silver-tipped Contact Screw	,,	0	5
,, ,,	308.	Core or Pole Piece	,,	0	3
,, ,,	309.	Coil Cheek	,,	0	3
,, ,,	310.	Lamp Holder	,,	0	3
,, ,,	311.	Best Metal Filament Lamp	,,	0	6
,, ,,	312.	27 Gauge Bare Iron Wire, per length of 30″		0	1
,, ,,	313.	26 Gauge SCC Copper Wire, Reels of 50 yds.		2	3
,, ,,	314.	23 Gauge SCC Copper Wire, ,, 25 ,,		2	0
,, ,,	315.	22 Gauge Bare Copper Wire, ,, 4 ,,		0	3

Results of Meccano Model-Building Contests

By Frank Hornby

"September" Competition, Overseas Section

ON looking through the entries in this Section of the "September" Competition, I was greatly impressed by the number of really excellent models submitted. Overseas Meccano boys have certainly excelled themselves this time!

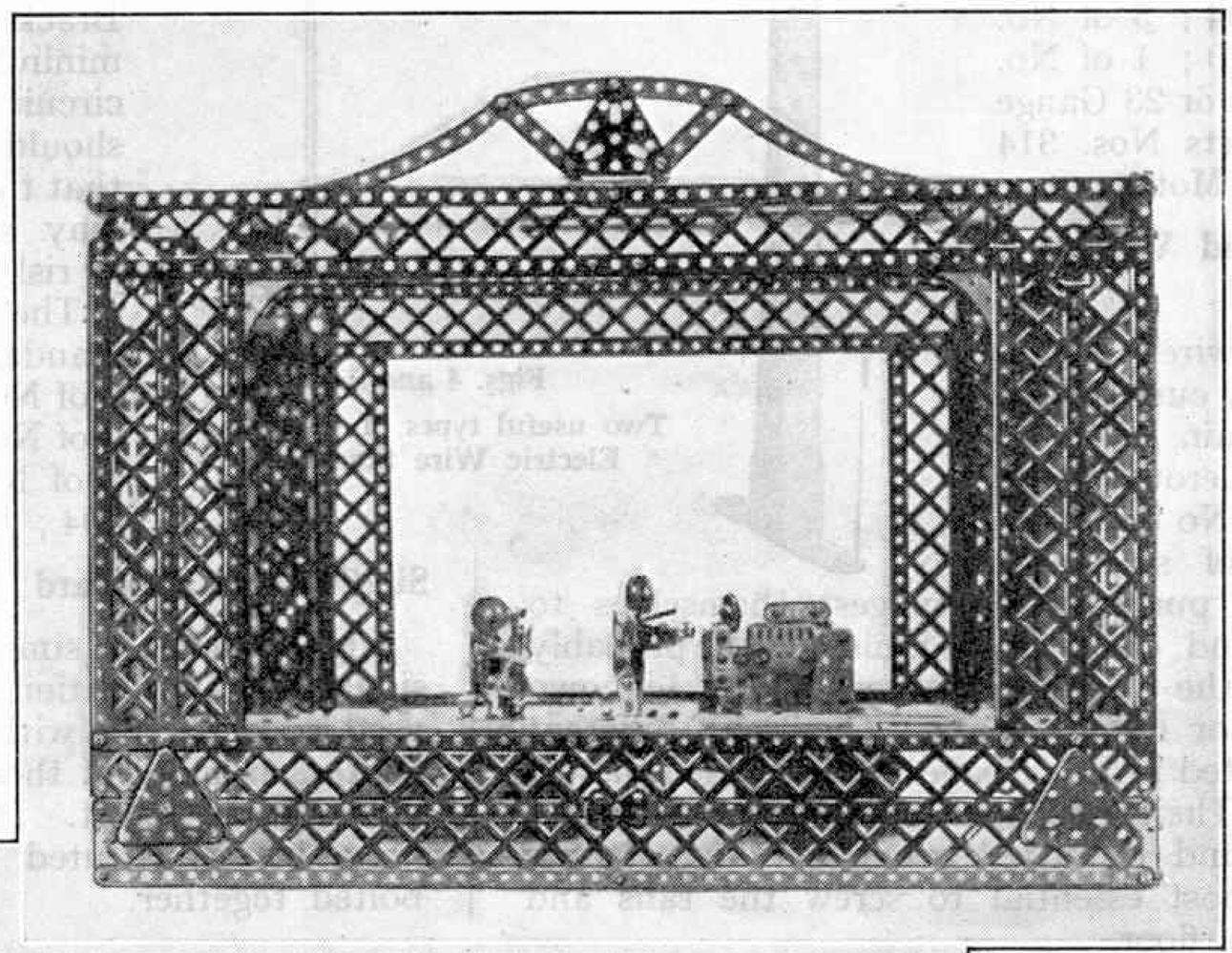
The names of the principal prize-winners are as follows:—

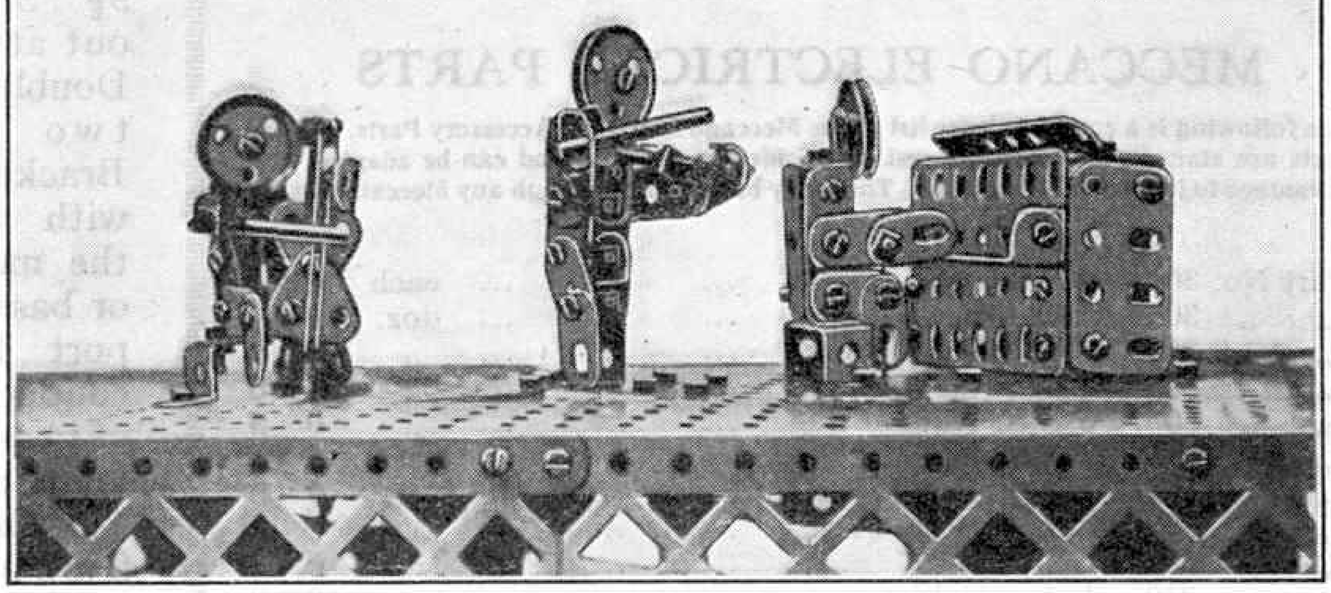
FIRST PRIZE (cheque to value £3-3s.): Alex van Dam, Sumatrastraat, Amsterdam, Holland. SECOND PRIZE (cheque to value £2-2s.): Fritz Herzig, Lotzwil, Bern, Switzerland. THIRD PRIZE (cheque to value of £1-1s.): R. O. Jukes, Timaru, S. Canterbury, New Zealand.

SIX PRIZES, each consisting of Meccano products to the value of 10/6: Frank E. N. Tuck, Hamilton, New Zealand; M. Saxby, Hawkes Bay, New Zealand; Grosvenor Morgan, Wellington, New Zealand; Piet Dal, Utrecht, Holland; Carlo Marini, Genoa; Walter A. Cooper, Elwood, Victoria.

TWELVE PRIZES, each consisting of Meccano products to the value of 5/-: Frederick Glass, Pernambuco, Brazil; Charles Brûlé, Willow Bunch Station, Saskatchewan, Canada; S. Van Leeuwen, Amsterdam, Holland; Desai S. Framroze, Navsari, India; Y. M. Bhave, Bombay, India; A. F. Setna, Vancouver, B.C.; P. Eisenmann, Biberist bei Solothurn, Switzerland; S. Foreman, Preston, Ontario, Canada; Fred Gerty, Chilliwack, B.C.; D. Taylor, North Perth, Western Australia; Kwa Soon Hock, Singapore, Straits Settlements; Maurice Jolivet, Breteuil sur Eton (Eure), France.

SPECIAL COMMENDATION (Certificates of Merit): Nickel and Eliazer van Straten, Amsterdam, Holland; Leslie Potter, Mosman, Sydney; Charles Galdes, Valletta, Malta; H. R. Harris, Ficksburg, O.F.S., S. Africa; B. Hamphill, Bay of Plenty, Auckland, New Zealand; Jack Somers, Brighton, Australia; G. Keller, Taumarunui, New Zealand; Rolando Schellenberg, Minisio Locarno; Fredrik Hennig, Valdres, Norway; Jan Hers, Franeker, Holland; Laurence McFarlane, Dunedin, New Zealand; Cyril Teary, Peterborough, S. Australia; Graeme A. Robson, Sydney, Australia.





The upper illustration shows the Meccano theatre built by M. Saxby. Below is a close-up view of the "orchestra," which consists of a pianist, a violinist, and a 'cellist!

In addition to the above awards, a number of other competitors will receive Certificates of Merit.

The first entry that attracted my attention was a wonderful representation of a sewing machine. Without doubt this is one of the finest models that have been entered in Meccano Model-building Competitions during the past few years, and I must congratulate Alex van Dam on producing with the aid it actually works in a most efficient manner is provided by a specimen that van Dam submitted along with his entry. This resembles in form a small tea cosy and was stitched throughout on the Meccano sewing machine. But for the fact that the stitches are perhaps a trifle large, it is practically impossible to tell that the article was not stitched on a machine of orthodox type.

The illustrations of the sewing machine shown on the opposite page scarcely do justice to the mechanical perfection of the model, but if one takes a peep inside an actual machine and then considers that all the mechanisms contained therein have been reproduced accurately by van Dam in his model, a better idea of its merits will be obtained. At first glance it would seem necessary that in order to reproduce the various movements correctly many articles foreign to Meccano would have to be employed. But this is not the case, for apart from a special shuttle and needle all the parts found in the Meccano sewing machine are standard to the system. This model will be rebuilt in our own Model Department at the earliest opportunity, and when it is ready I hope to include full particulars of it in the *"M.M."*

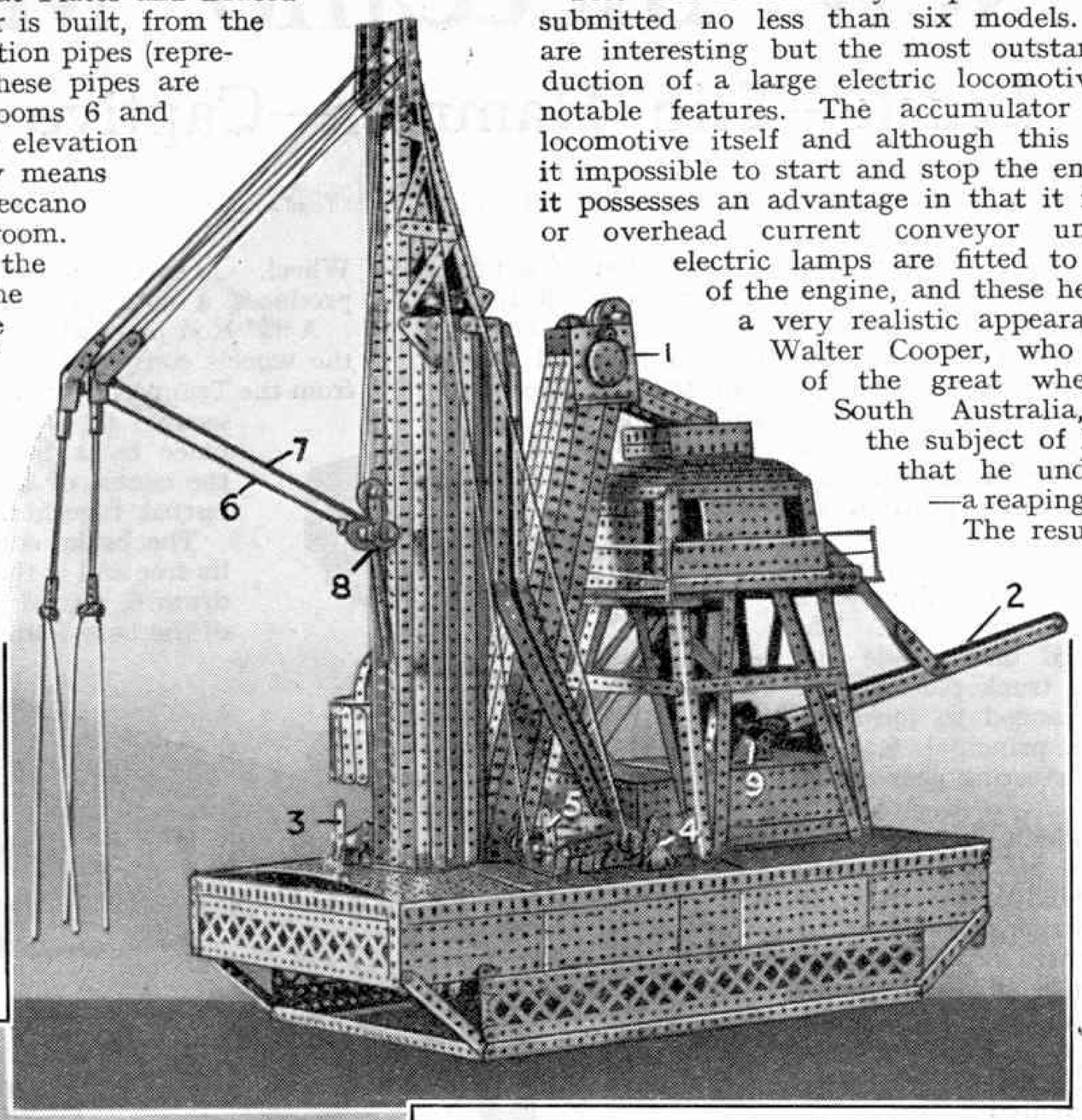
Fritz Herzig, winner of the Second Prize, submitted as his entry a model of an electric freight locomotive. This is a very fine effort and the photographs before me show the locomotive traversing a large viaduct, which is also built entirely from Meccano. The pantographs, or current collectors, are built up from Strips, and they appear somewhat out of proportion. I think if Rods and Couplings were used in their place, a neater finish would be given to the model. Nevertheless the locomotive is a very fine example of Meccano engineering, and I have no doubt that it looks most impressive when travelling along its overhead track.

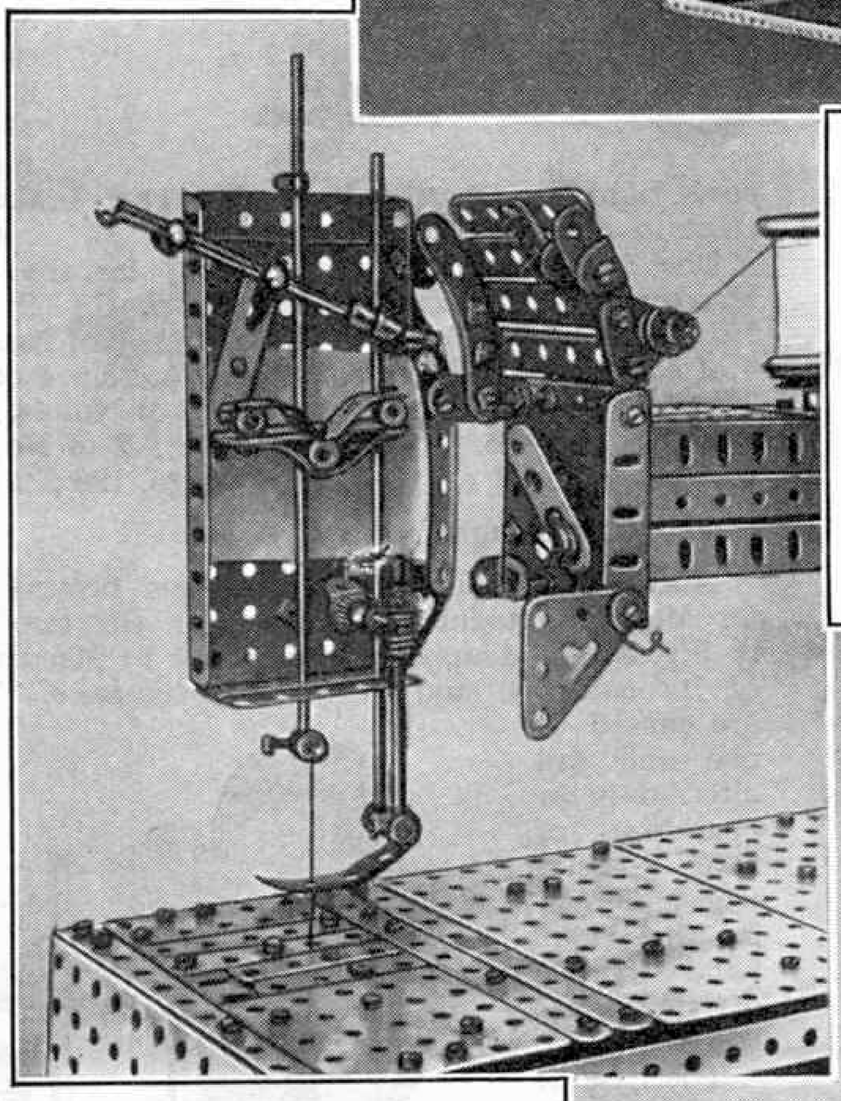
A model of a pneumatic or suction grain elevator, an illustration of which appears on the opposite page, secured Third Prize for R. O. Jukes. In the March, 1927, issue of the *"M.M."* we described some elevators of this type that are employed in the Port of London, and readers who are able to refer to that issue will be able to see for themselves that Jukes' model is a very clever reproduction of the actual machine. Many Meccano boys will be conversant with the action of suction elevators but a

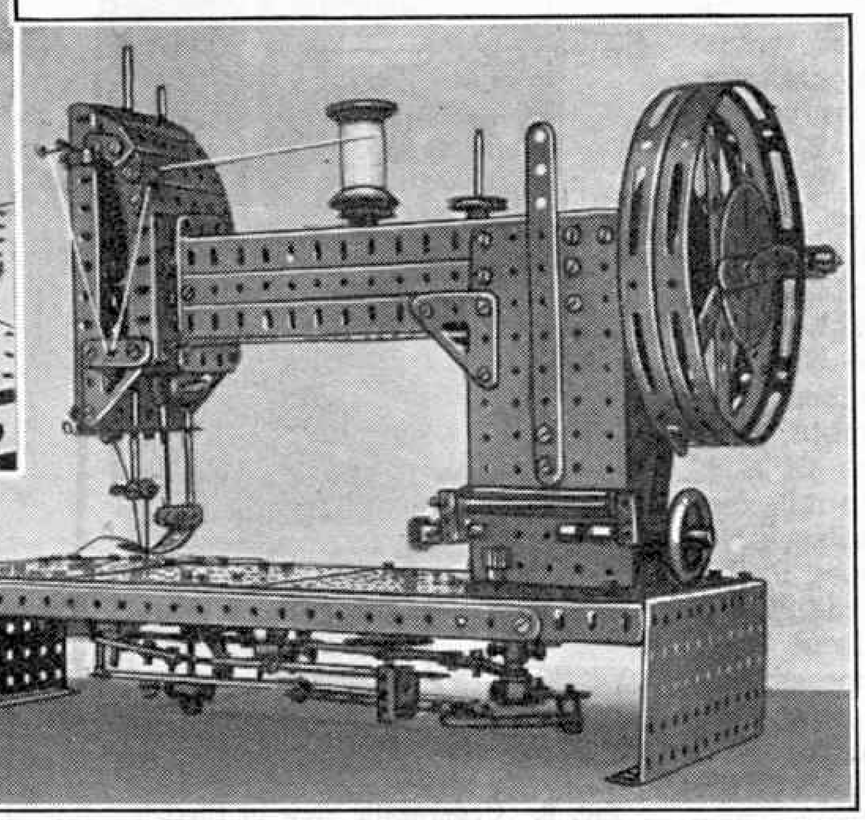
little explanation may be useful for those who have not seen one in action.

The base of the elevator consists of a large barge or pontoon, which in the model is built up from Flat Plates and Braced Girders. On this base an upright tower is built, from the top of which are suspended a pair of suction pipes (represented by lengths of Spring Cord). These pipes are connected by flexible joints to pipe booms 6 and 7 that open into the main tower. The elevation of the booms can be varied at will by means of the winch 4, which is driven from a Meccano Electric Motor fitted in the engine room.

When grain is to be unloaded the suction pipes are let down into the hold of the vessel by means of the winches 3 and 5. The "exhausters" are then set in action and the vacuum thereby created causes the grain to be drawn up the suction pipes, through the pipe booms 6 and 7, and so into the tower. When the grain reaches the bottom of the tower, dust is removed by means of a dust extractor placed near the base of the tower, and the grain is then carried through the container 1 until it reaches the weighing room. After having been weighed it is either deposited by means of the belt 2 into storage bins on the dockside or is discharged through the pipes that can be seen projecting from the floor of the weighing room. The winch 9 is used to raise or lower the belt elevator 2. Although the pneumatic method of operation cannot actually be reproduced in the model, of course, the remainder of the mechanism is quite true to that employed in the original elevator. R. O. Jukes has certainly devised a most interesting model.







Above: a fine model of a Pneumatic Grain Elevator, built by R. O. Jukes (awarded Third Prize). Below: broadside view of the Sewing Machine with which Alex van Dam secured First Prize and (left) view showing the "head" opened. The mechanism operating the needle can clearly be seen in this illustration.

A Meccano theatre was the subject of a very unusual and amusing entry from M. Saxby. Two views of the theatre are included in the accompanying illustrations. The lower view is a close-up of the "orchestra," which comprises a pianist—with Flat Brackets for hands!—a violinist, and a 'cellist. Even when motionless the figures have a very realistic appearance, and the effect produced when they are set in motion (by means of cords worked from behind the scenes) must be still more remarkable. It must indeed be amusing to observe the pianist playing (?) on the Meccano piano and the violinist and 'cellist trying to keep time with him, while in spite of their efforts not a sound is heard, of course. Meccano boys who have read "Adventures in Meccanoland" will agree that these figures look as though they have stepped straight out of that weird and wonderful country!

Carlo Marini submitted the neatest model that I have seen for some time. It represents a racing motor car and although it is little over 7" in length it is very cleverly designed and has a distinctly speedy appearance. I shall illustrate this model in a future issue of the *"M.M."*

Piet Dal is evidently a prolific model-builder, for he submitted no less than six models. All of his entries are interesting but the most outstanding one—a reproduction of a large electric locomotive—possesses several notable features. The accumulator is fitted into the locomotive itself and although this arrangement makes it impossible to start and stop the engine from the track, it possesses an advantage in that it renders a centre rail or overhead current conveyor unnecessary. Meccano electric lamps are fitted to the front and rear of the engine, and these help to give the model a very realistic appearance.

Walter Cooper, who lives in the heart of the great wheat-growing area of South Australia, wisely chose as the subject of his model a machine that he understands thoroughly—a reaping and binding machine. The result is a most realistic working model that, in addition to cutting down the "corn," also forms it into bundles and binds a length of cord around each bundle. The only material used in the construction of the model in addition to standard Meccano parts is a few strips of paper that form the conveyor belts.

Another very interesting entry was a steam shovel by Frank Tuck. Although the model is driven by a 4-volt Electric Motor the various working parts of the actual steam shovel are reproduced so well that the model has every appearance of being driven by steam! A Meccano chimney and built-up cylinder on each side add to the deception.

In view of his age, which is only 10, Grosvenor Morgan sent in a very creditable entry. His model is in the form of a battleship fitted with large and small guns, bridge, boats, davits, etc. A neat "crows-nest" consists of a Coupling secured to the mast with a ¾" Contrate Wheel, having its teeth pointing upward, placed immediately above it.

Amongst the other prize-winning models I noticed a very interesting small scale 0–6–0 tank locomotive by Sherlock Foreman. It is constructed from a No. 4 Outfit and is designed to run on Gauge 0 rails.

As is usually the case, Meccano motor cars and cranes of all descriptions were much in evidence. A neat representation of a racing car secured an award for Donald Taylor, and a very realistic breakdown crane carried off a prize for Charles Brûlé. A crane also formed the subject of Adolph Setna's prize-winning entry.

New Meccano Models

Electric Truck—Trip Hammer—Captive Flying Machine

THE model shown in Fig. 1 is a realistic reproduction of a type of electrically-operated truck used in railway stations, factories, etc., for the expeditious handling of luggage or materials. No doubt Meccano boys have often admired these trucks for their power and easy control. In practice they are driven by a small electric motor that is usually mounted in the back axle, and the necessary current is derived from a battery or accumulator stored in an unobstrusive position on the truck.

The Meccano model would be improved greatly by the addition of a Clockwork Motor as the means of propulsion. The Motor could be placed on its side and mounted beneath the truck platform, or it might even be arranged to form the platform itself. The principal features of the model are the steering gear and a foot-operated brake.

The platform on which the goods are carried consists of a $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate, which is extended at the front by means of three $2\frac{1}{2}''$ Strips placed side by side and extending three holes from the Plate. The outer ends of these Strips are connected transversely by a $1\frac{1}{2}''$ Strip. The vertical support for the driver's seat consists of five $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips bolted in a vertical position, as shown. The two end Double Angle Strips are connected together at the top by a $2\frac{1}{2}''$ small radius Curved Strip, and the seat is formed by a Trunnion bolted to this Curved Strip and to the centre Double Angle Strip. Further supports for the vertical Double Angle Strips are provided by $2\frac{1}{2}''$ Curved Strips bolted to each end of another $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip bolted transversely to the vertical Strips.

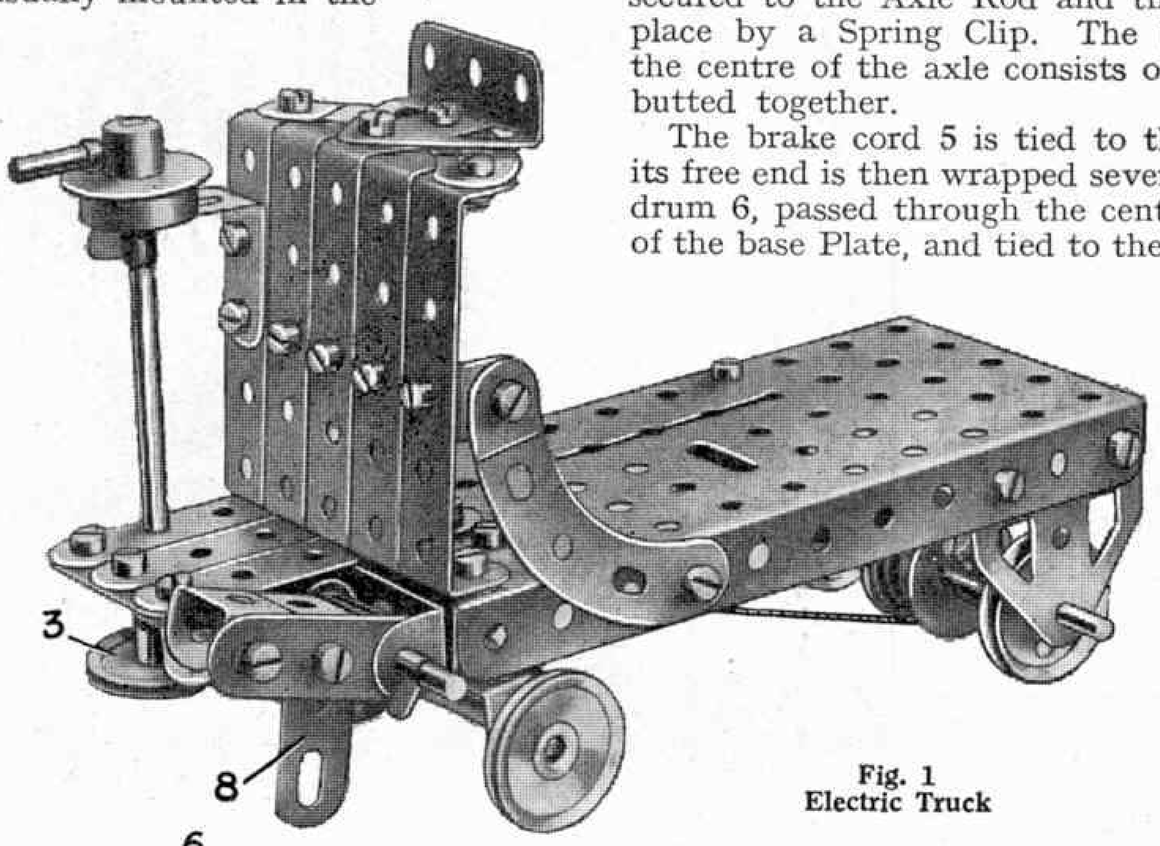


Fig. 1
Electric Truck

The steering gear will be followed from Fig. 2, which shows the underneath of the truck. The 1″ fast Pulleys forming the front travelling wheels are secured to a 2″ Rod journalled in the $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip 1. The latter is attached pivotally to the Double Bent Strip 2 by means of a $\frac{3}{8}''$ Bolt and lock-nuts (see Standard Mechanism No. 263), and a $\frac{1}{2}''$ loose Pulley is placed between the Strip 1 and the Double Bent Strip 2 for spacing purposes.

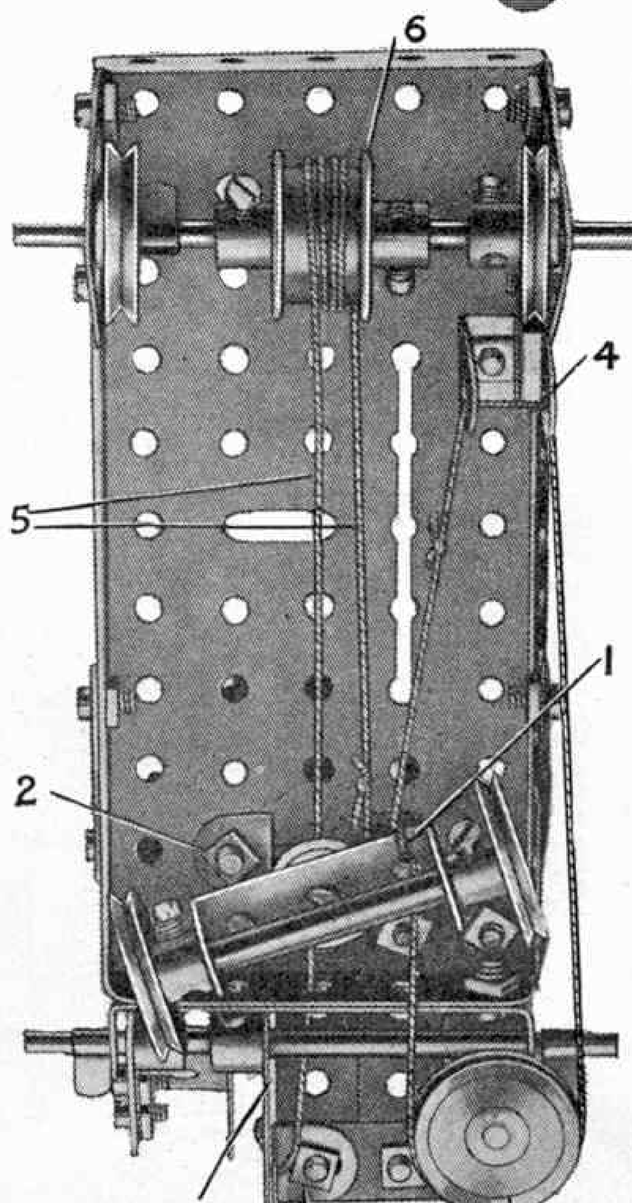


Fig. 2. Underneath View of Electric Truck

The front axle is steered by means of a cord, both ends of which are tied to the Double Angle Strip 1. The cord passes through the holes in a Cranked Bent Strip 4 and is given a complete turn round the 1″ Pulley Wheel 3. This Pulley 3 is secured to a $3\frac{1}{2}''$ Rod, which forms the steering column and is journalled in one of the $2\frac{1}{2}''$ Strips at the front of the truck and in a $1'' \times 1''$ Angle Bracket bolted to one of the vertical $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips. The steering lever consists of a Threaded Pin inserted in the boss of a $\frac{3}{4}''$ Flanged Wheel. A small movement of this lever actuates the cord and produces a corresponding movement in the front axle.

A $3\frac{1}{2}''$ Rod journalled in Flat Trunnions forms the back axle, and the wheels consist of one 1″ fast and one 1″ loose Pulley spaced from the Trunnions by means of Washers. The fast Pulley Wheel is secured to the Axle Rod and the loose Pulley is held in place by a Spring Clip. The brake drum mounted in the centre of the axle consists of two $\frac{3}{4}''$ Flanged Wheels butted together.

The brake cord 5 is tied to the Double Bent Strip 2; its free end is then wrapped several times round the brake drum 6, passed through the centre hole in the end flange of the base Plate, and tied to the centre hole of a Crank 8. The latter is secured to a $3\frac{1}{2}''$ Rod that is journalled in a $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip bolted to the end flange of the $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate. The foot lever operating the brake consists of two Double Brackets bolted to a second Crank that is also secured to the $3\frac{1}{2}''$ Rod. The tension of the cord should be adjusted so that a slight pressure on the foot lever draws the cord tight round the drum 6. This brake proves most efficient in operation.

The following parts are required for the construction of the Meccano Electric Truck:—3 of No. 5; 2 of No. 11; 1 of No. 12; 1 of No. 12a; 3 of No. 16; 1 of No. 17; 3 of No. 20b; 4 of No. 22; 1 of No. 22a; 1 of No. 23; 4 of No. 35; 30 of No. 37; 1 of No. 37a; 2 of No. 28; 1 of No. 44; 1 of No. 45; 1 of No. 48; 7 of No. 48a; 1 of No. 52; 2 of No. 62; 3 of No. 90a; 1 of No. 111c; 1 of No. 115; 1 of No. 126; 2 of No. 126a.

Double Trip Hammer

Automatic hammers have always proved a popular subject for Meccano models, and we think the trip hammer illustrated in Fig. 3 should appeal particularly to Meccano boys on account of its compact and realistic appearance. The two hammers are caused to rise and fall alternately on operation of the hand wheel shown in the right hand corner of the illustration.

The base of the Double Trip Hammer is a $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate on which two Sector Plates are mounted in a vertical position. The guides for the hammer consist of two $3\frac{1}{2}''$ Strips, which are bolted between the

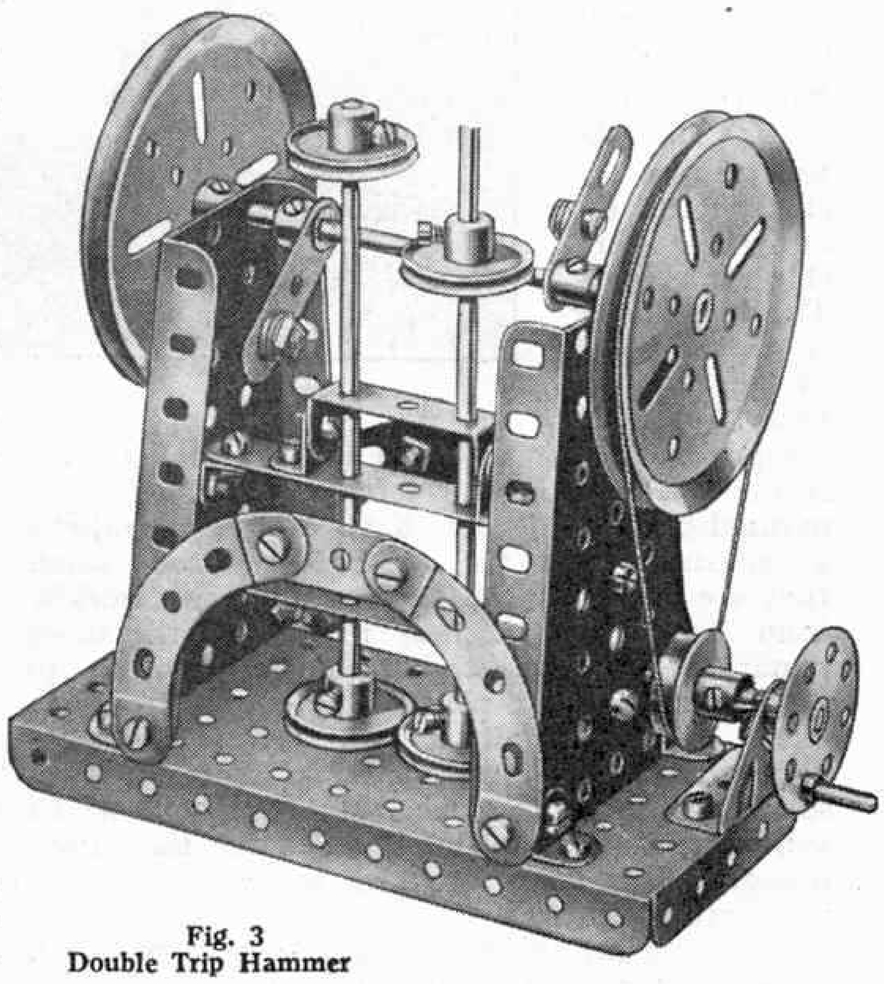


Fig. 3
Double Trip Hammer

Sector Plates by means of Angle Brackets, and a $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip secured to two Angle Brackets that, in turn, are bolted to the upper $3\frac{1}{2}''$ Strips.

The hammers consist of 1" fast Pulleys secured to $4\frac{1}{2}''$ Rods. A second pair of 1" Pulleys secured to the upper ends of these Rods are lifted alternately by tappets, which consist of $\frac{3}{4}''$ Bolts fitted with Washers and secured to Cranks that, in turn, are secured to a $4\frac{1}{2}''$ Rod forming the tappet shaft. The operating handle consists of a Threaded Pin secured to a Bush Wheel and is mounted on a 2" Rod that is journalled in a Trunnion bolted to the base Plate and in one of the holes of the upright Sector Plate. A cord connects one of the 3" Pulleys on the tappet shaft with a $\frac{3}{4}''$ Flanged Wheel on this 2" Rod.

The parts required to build the model are as follows: 2 of No. 3; 2 of No. 6a; 10 of No. 12; 3 of No. 15; 1 of No. 17; 2 of No. 19b; 1 of No. 20b; 4 of No. 22; 1 of No. 24; 1 of No. 35; 32 of No. 37; 4 of No. 38; 1 of No. 48; 1 of No. 52; 2 of No. 54; 2 of No. 62; 4 of No. 90a; 1 of No 115; 1 of No. 126.

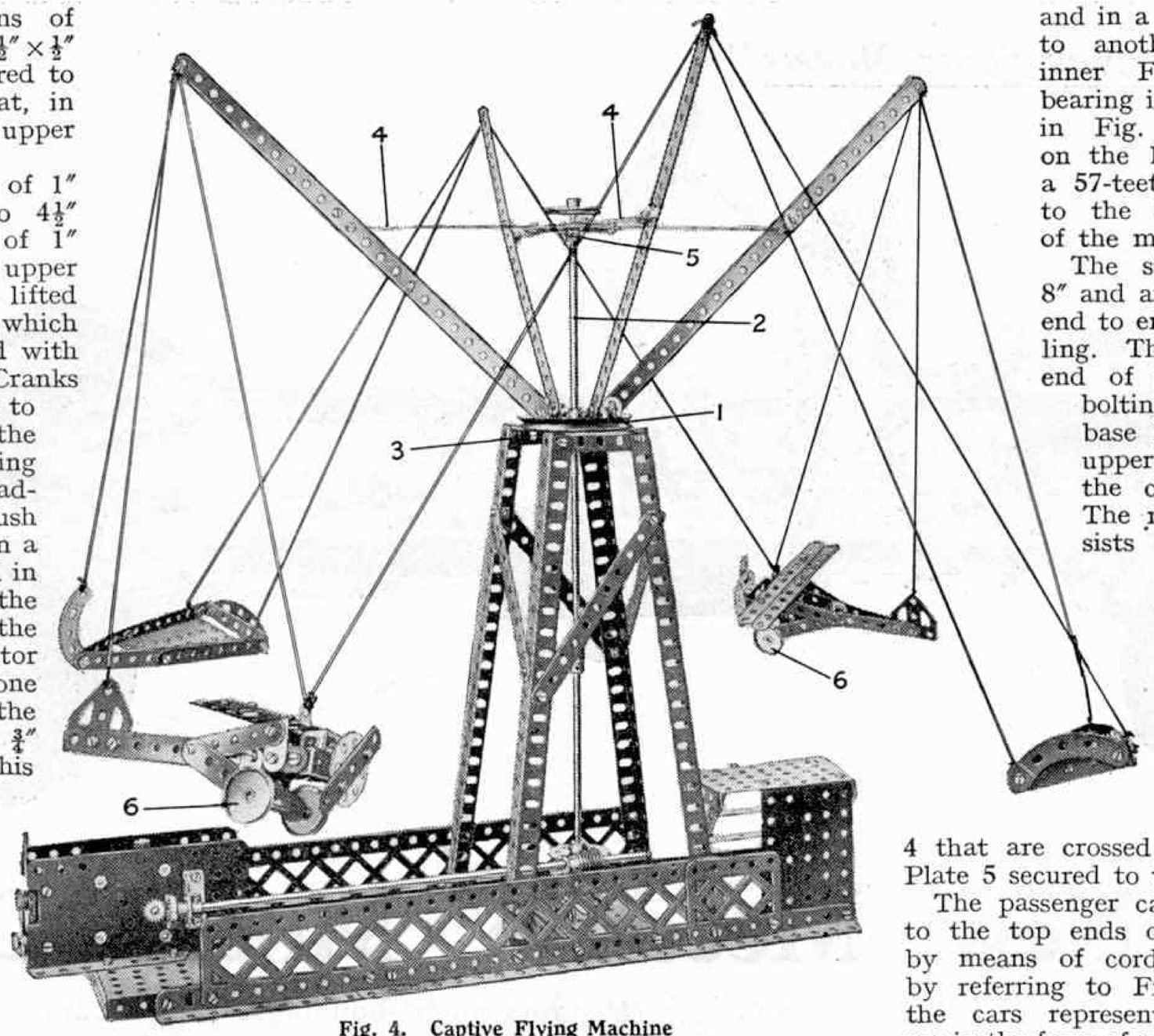


Fig. 4. Captive Flying Machine

Captive Flying Machine

Most Meccano boys will be familiar with the prototype of the model shown in Fig. 4, for nowadays it is to be found at almost every pleasure fair or other place of amusement. It is much more thrilling than the ordinary roundabout in that the cars carrying the passengers rise higher and higher as the speed of the machine increases.

Before starting the model it should be decided what form of power is to be used. Fig. 4 shows the model driven by a 4-volt Electric Motor, suitably mounted in the base, but if it is desired to work the model by hand, the base should be built as shown in Fig. 5. The side members for the base in each illustration consists of $12\frac{1}{2}''$ and $5\frac{1}{2}''$ Angle Girders bolted end to end, and they are spaced apart by $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plates and a $5\frac{1}{2}''$ Angle Girder secured in the positions shown in Fig. 5. The landing platform consists of a $3\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate bolted to another similar plate that is secured in a vertical position at one end of the base. The steps are formed from four $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips bolted between the two $4\frac{1}{2}''$ Strips.

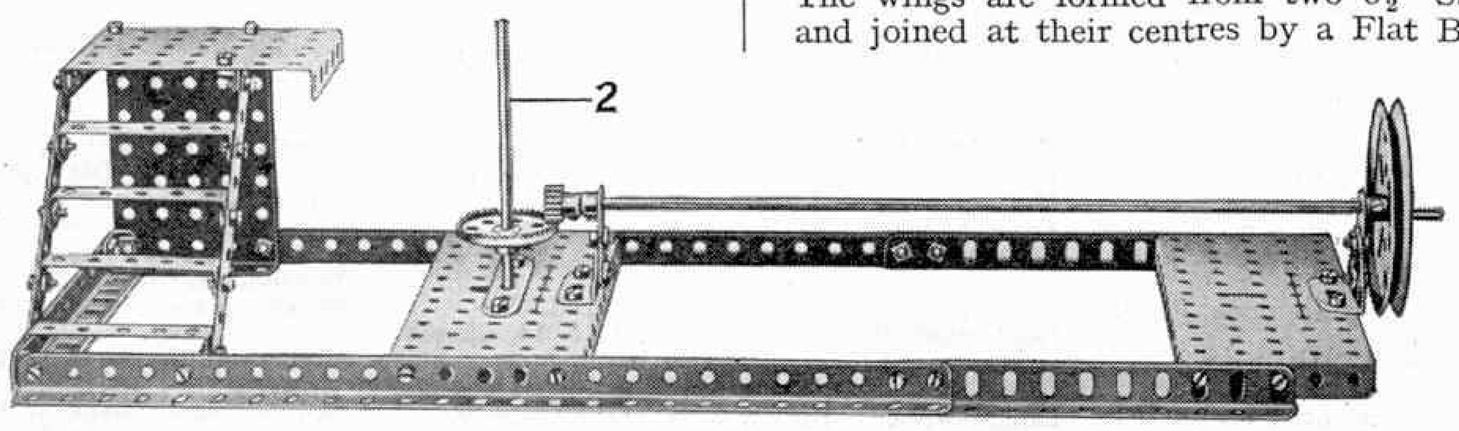


Fig. 5. Alternative construction of base of Captive Flying Machine, arranged for hand operation

The main tower consists of four $12\frac{1}{2}''$ Angle Girders bolted to the base Girders and to the corners of a $3\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate 3 at the top. Four $5\frac{1}{2}''$ Strips are bolted obliquely between the Angle Girders of the tower to give increased stability.

If an Electric Motor is used as the source of power, it should be bolted to the end Flanged Plate of the base, as shown. A $\frac{1}{2}''$ Pinion secured to the armature spindle engages with a $\frac{3}{4}''$ Contrate Wheel on a horizontal $11\frac{1}{2}''$ Axle Rod, which is journalled in a Trunnion secured to the side of the Motor and in a $1\frac{1}{2}''$ Strip that is bolted to another Trunnion on the inner Flanged Plate. This bearing is similar to that shown in Fig. 5. A Worm Wheel on the $11\frac{1}{2}''$ Rod engages with a 57-teeth Gear Wheel secured to the main vertical stem 2 of the model.

The stem 2 consists of an 8" and an $11\frac{1}{2}''$ Axle Rod joined end to end by means of a Coupling. The bearing for the lower end of the stem is made by bolting a $2\frac{1}{2}''$ Strip to the base Flanged Plate, and the upper end passes through the centre of the Plate 3. The revolving structure consists of four $12\frac{1}{2}''$ Strips fastened by Angle Brackets to the 3" Pulley 1, which is secured to the Rod 2 and separated from the Plate 3 by a few Washers. The $12\frac{1}{2}''$ Strips are supported near their centres by two further $12\frac{1}{2}''$ Strips 4 that are crossed and bolted to a Face Plate 5 secured to the Rod 2.

The passenger cars, which are attached to the top ends of the four $12\frac{1}{2}''$ Strips by means of cord, can easily be made by referring to Figs. 4 and 6. Two of the cars represent aeroplanes and two are in the form of gondolas or boats. These latter are built up from Sector Plates connected to $3\frac{1}{2}''$ Strips that are brought to a point in front and finished with $2\frac{1}{2}''$ Curved Strips.

Fig. 6 shows one of the aeroplanes in detail. The fuselage consists of two $5\frac{1}{2}''$ Strips bolted at the rear to a Flat Trunnion and separated at the front by a $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip. The wings are formed from two $5\frac{1}{2}''$ Strips placed side by side and joined at their centres by a Flat Bracket. They are bolted to $1'' \times 1''$ Angle Brackets that, in turn, are bolted to the fuselage and held in position by $2\frac{1}{2}''$ Strips. The undercarriage consists of two $2\frac{1}{2}''$ Strips held out at an angle to the fuselage by Flat Brackets. The Rod carrying the 1" Pulleys 6 (shown detached in the illustration) is journalled in the end holes of these $2\frac{1}{2}''$ Strips.

Other forms of cars may, of course, be attached to the model if desired, and no doubt ingenious Meccano boys will be able to devise many interesting shapes for the purpose. For example, small models of airships could be substituted for the gondolas and would be more in keeping, perhaps, with the aeroplanes. The airships may easily be built up from a number of Strips, etc., and a propeller should be fitted at one end to add interest and movement.

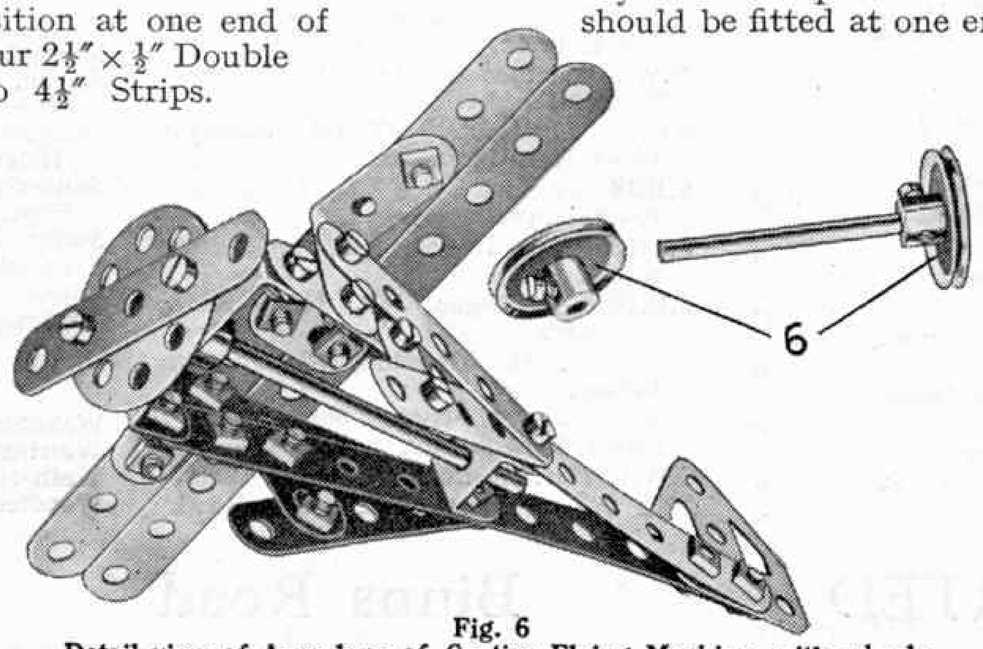
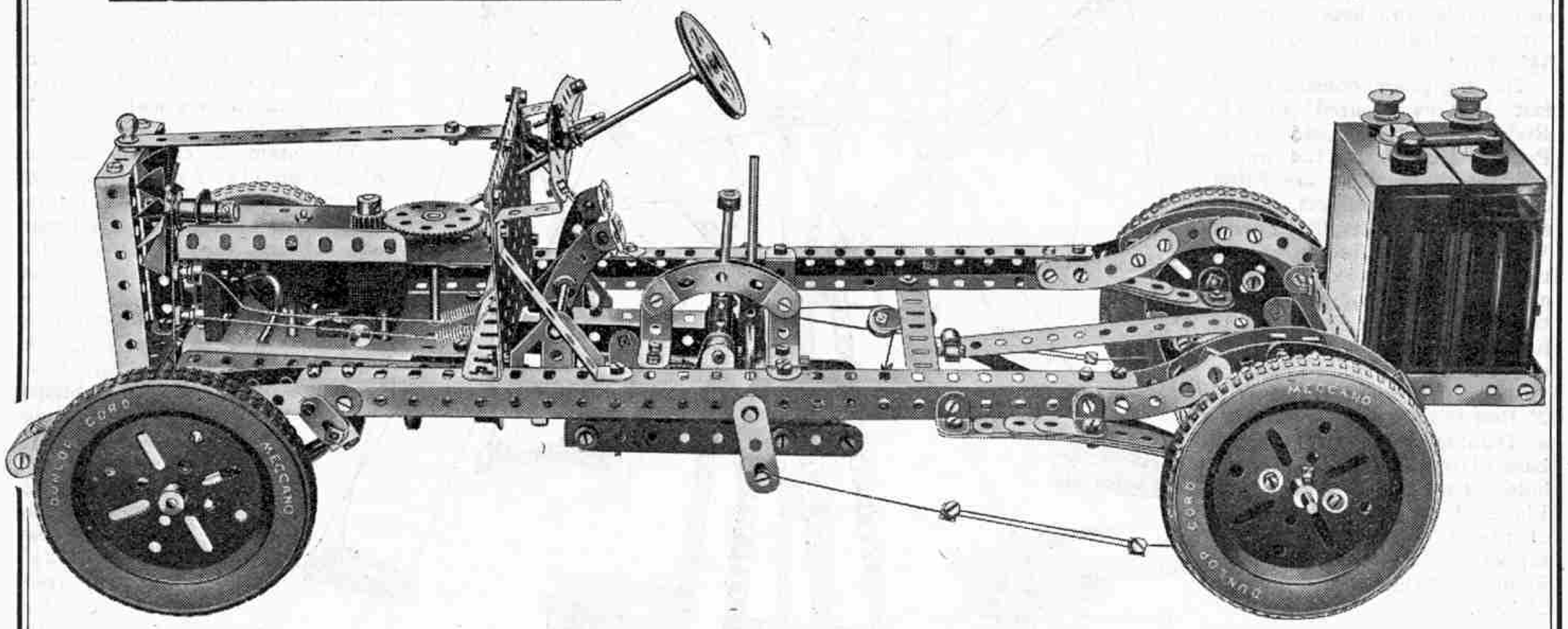


Fig. 6
Detail view of Aeroplane of Captive Flying Machine, with wheels detached

The following parts are required to build the Captive Flying Machine as illustrated in Fig. 4:—6 of No. 1; 2 of No. 2a; 4 of No. 3; 10 of No. 5; 1 of No. 6a; 6 of No. 8; 1 of No. 9; 6 of No. 10; 2 of No. 11; 13 of No. 12; 4 of No. 12a; 2 of No. 13; 1 of No. 13a; 2 of No. 16; 2 of No. 17; 2 of No. 19b; 4 of No. 22; 2 of No. 24; 1 of No. 26; 1 of No. 27a; 1 of No. 29; 1 of No. 32; 107 of No. 37; 4 of No. 38; 2 of No. 48; 6 of No. 48a; 2 of No. 52; 3 of No. 53; 2 of No. 54; 1 of No. 59; 1 of No. 63; 2 of No. 90a; 1 of No. 98; 2 of No. 99; 1 of No. 109; 2 of No. 126; 2 of No. 126a; 1 4-volt Electric Motor.

"One of the New Super Models"



The New Meccano Motor Chassis

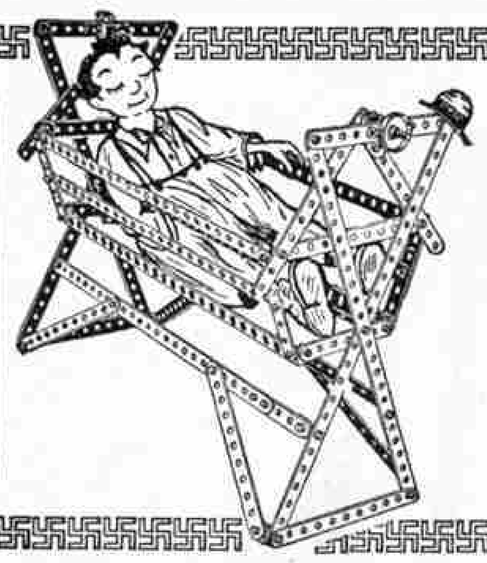
This splendid Motor Chassis is a triumph of Meccano model-building. It is accurately constructed on correct principles and includes all the important details of automobile practice—Differential Gear, Ackermann Steering, Gear Box (3-speed and reverse), Internal Expanding Rear Wheel Brakes, etc.

Full instructions for building this model, with illustrations in half-tone, are given in an 8-page folder, which may be obtained from your dealer, price 3d., or direct from Meccano Ltd., Binns Road, Liverpool, price 3d. post free.

The undermentioned Meccano dealers have purchased models of the new Motor Chassis for demonstration purposes. Every Meccano boy who is within easy distance of any of these stores should make a point of seeing these splendid models.

Alnwick. Lion Garages Ltd., Bondgate.
Altrincham. Harry Brown, 1, Moss Lane.
Bath. J. S. Common & Son, 12a, Corridor.
Beeston, Notts. J. E. Blower, 38, High Road.
Bexhill-on-Sea. Barker's Library & Stores Ltd., 40, Devonshire Road.
Birmingham. F. Gardner, 134, Anderton Road, Sparkbrook.
Blackpool. Batesons, Abingdon Street.
Bolton. James Morris, 70, Knowsley Street.
Bournemouth. Bright & Colson Ltd., 14/26, Old Christchurch Road.
Bradford. W. Carter, 15, Bridge Street.
Bristol. W. Browning, 71, Grosvenor Road, St. Paul's.
Burnley. Dean, 3 & 5, St. James' Row.
Bury. C. S. Taylor, 16, Silver Street.
Cardiff. H. Salanson & Co. Ltd., 4, High Street.
Carlisle. Robinson Bros. (Carlisle) Ltd., English Street.
Cheadle. Higgin & Hilton, 40, High Street.
Chelmsford. F. Spalding & Sons Ltd., 4–5, High Street.
Coventry. R. H. Jepson, 1, Cross Cheaping.
Croydon. C. Hewitt & Son, 45/47/49, Church Street.
Dartford. Phillips & Co., 78, High Street.
Darwen. Whalley, 95, Duckworth Street.
Didsbury. A. Inman, Moorfield Arcade, 105, Lapwing Lane.
Dumfries. Robert Elder, 44, English Street.
Edinburgh. Mr. J. McIntyre, 130, Easter Road.
Elland. C. H. Carter, Bridge End P.O.
Falkirk. Alexanders Stores, 150, High Street.
Galashiels. J. Gray, 6 & 8, Market Street.
Gateshead. S. McD. Selby, 6, Prospect Terrace, Low Fell.
Glasgow. Copland & Lye Ltd., Caledonian House, Sauchiehall Street.
Gloucester. T. G. Hull, 25/27, Barton Street.
Harrow, Middlesex. H. H. Pritchett, 42, St. Ann's Road.
Hounslow. H. Poulton, 69/75/77, High Street.
Huddersfield. Rushworths Ltd., 2, Westgate.
Hull. Hammonds Ltd., Paragon Square.
Hyde. S. Leigh, 150, Market Street.
Kidderminster. The Castle Motor Co. Ltd., Vicar Street.
" H. Smith, 6, New Road.
Launceston. W. S. Cater & Co., 12 & 14, Church Street.
Leeds. Monteith, Hamilton & Monteith, Boar Lane.
Leigh-on-Sea. T. Back & Sons, 114, Broadway.
Liverpool. Bunneys Ltd., Church Street.
" Lewis's, Renshaw Street.
" C. Lucas, 35, Manchester Street.
" R. B. Walker, 83, Moss Lane, Orrell Park, Aintree.
London, E.8. Wain & Son, F. J., 478, Kingsland Road, Dalston.
" E.C.2. Benetfink & Co. Ltd., 107/110, Cheapside.
" N.4. H. Peters, 10, Station Road. Finsbury Park.
" N.15. W. G. Ames, 693 & 697, Seven Sisters Road, South Tottenham.
" N.W.3. Welton & Messent, 5, Pond Street, Hampstead.
" S.E.10. C. Noble, 107/109, Trafalgar Road, East Greenwich.
" S.E.18. Arundel Cycle Co., 52, Church Road, Upper Norwood.
" S.E.18. Hugh Ingram Ltd., 8, Thomas Street.
" S.E.18. A. Logan, 47, New Road, Woolwich.
" S.E.2. C. H. Titterton, 89, Dulwich Village.
" S.W.1. Mr. J. Gash, 36a, Regency Street, Westminster.
" S.W.1. Harrods Ltd., Brompton Road.
" W.2. Wm. Whiteley Ltd., Queens Road.
Manchester. Droylesden Co-op. Soc. Ltd., 1330, Ashton Old Road, Hr. Openshaw.
Manchester. E. Eady, 94, Church Lane, Harpurhey.
" F. Thorpe, 22, Upper Jackson Street, Hulme.
Menston. A. Outtersides, Cadema Bakery.
Mossley, Lancs. E. Howard, 3, Stockport Road, Brookbottom.
Motherwell. J. Cartwright, 16–18, Windmillhill Street.
Newcastle-under-Lyne. W. Hill, 4, Red Lion Square.
" L. C. Kendrick, 82, George Street.
Newcastle-on-Tyne. Wm. Olliff, 13, Grainger Street West.
Perth. J. Anderson, 15, St. John Street.
Preston. R. Marsden & Son Ltd., 115, Church Street.
Renfrew. J. Orr, 120, Paisley Road.
Ruislip. A. Morris, The Greenway, 2, Station Parade.
Runcorn. Coventrys, 45, Devonshire Square.
Sedbergh, Yorks. Jackson & Son, Main Street.
Selby. T. Abbey, 38, Ousegate.
Sheffield. The Redgate Co. (Sheffield) Ltd., Moorhead.
" W. A. J. Tinker, 20, London Road.
Shrewsbury. R. Mansell & Sons, 17, Wyle Cop.
Sidcup. Carveth Rowe, The Library, 43, High Street.
Sittingbourne. F. C. E. Cleaver, 53/59, West Street.
St. Helens. B. Brooks, 26, Duke Street.
Sunderland. J. F. Strother, 58/61, High Street West.
Sutton Coldfield. Christopher Cadby & Son, 111, Parade.
Totnes, Devon. P. Pinch, 65, High Street.
Tunbridge Wells. R. Carey (Tunbridge Wells) Ltd. 34, Grosvenor Road.
" W. J. White, 30 & 34, Monson Road.
Wakefield. The Eagle Press, Wood Street.
Warrington. Warrington Co-op. Soc. Ltd.
Wath-on-Dearne. Wm. Walton, High Street.
Woodford Green. W. Jackson, 56 & 58, High Road.

MECCANO LIMITED Binns Road LIVERPOOL



New Meccano Model-Building Contest

CHEQUES, 'PHONES AND MECCANO GOODS AS PRIZES!

A SPECIAL feature of the "May" Meccano Model-building Competition is the fact that thirteen Meccano Double Headphones are included in the list of prizes. We have no doubt that these splendid awards will help to induce *"M.M."* readers—especially those who are radio enthusiasts—to submit their very best work. The Meccano Double Headphones are of the highest quality procurable. They are of 4,000 ohms resistance and will give loud, clear and undistorted reception, thereby adding greatly to the efficiency of any wireless set. In addition, they are comfortable to wear and easily adjusted.

Any successful competitor who becomes entitled to a pair of Meccano Headphones and who already possesses a set of these instruments will be allowed to choose in their place Meccano or Hornby Train goods to the value of ten shillings and sixpence.

This Model-building Competition is designed merely as an incentive to Meccano boys to exercise their inventive abilities, and as a means of collecting new ideas for models and movements, etc., so that these may be published from time to time for the benefit of Meccano boys all over the world. There are no entrance fees or forms but it is important that the instructions printed below should be observed very carefully. If a competitor fails to do so he may spoil his chance of winning a prize.



This is an illustration of the Meccano Double Headphones. Several of these fine instruments are offered as prizes.

Hints to Competitors

When about to construct a competition model, many Meccano boys place their Outfits before them and then try to think of a new model that they can build. This procedure is not the best method by which to set about winning a prize, however. What Meccano model-builders should do is to map out their models in their minds long before they start the actual construction. There should be no dearth of ideas for new models; to the boy who keeps his eyes open new suggestions will present themselves every day.

Give your imaginative powers full rein, put forward your best creative effort. and your success in the competition is certain. But do it now. Those who put off the construction of their models until "to-morrow" often find to their sorrow that the closing date of the competition has arrived while "to-morrow" is still just as distant!

Any number of parts may be used in the models submitted. A word of warning is necessary here; do not make the mistake of thinking that because you have a No. 7 Outfit you naturally stand a greater chance of winning a prize than a competitor who has only a 00 Outfit. As a matter of fact the owner of the 00 Outfit has just as good a chance of winning the First Prize as you have. Similarly, do not think that because you are not as old as another competitor you do not stand such a good chance of success. In this competition, as in all Meccano competitions, the age of the competitor is specially considered when the prizes are being awarded.

The best plan is to send a photograph of your model, of course, but if you cannot manage to obtain a good photograph a clear drawing will do as well. Neither photographs or drawings need be your own work, but the model itself must be the result of your own unaided efforts. Whether you send a photograph or a drawing you should state what your model is and mention any points of particular interest. If there are any details in your model that are not very clear, you should write out the necessary explanation, using one side of the paper only, and send it along with the photograph or drawing.

In order to carry off a big prize in a Meccano model-building contest one need not necessarily be an inventive genius. Any boy with average intelligence can enter this competition with the knowledge that he has a good chance of winning a prize.

Important Instructions

The competition will be divided into three different Sections, as follows:—Section A, for competitors residing in the British Isles and over 14 years of age. Section B, for competitors residing in the British Isles and under 14 years of age. Section C, for competitors of all ages residing overseas.

Read the following instructions and regulations carefully and make sure you have observed every condition of entry before sending in your work:—

It is absolutely essential that any model entered in the Competition must be your own unaided work as regards both design and construction.

Do not send the actual model. Your photographs or drawings, if unsuccessful, will be returned providing that a stamped addressed envelope of the necessary size is enclosed with your entry. Prize-winning photographs become the property of Meccano Ltd.

More than one model may be entered in the competition, but all entries from any single competitor must be sent under the same cover. No single competitor can win more than one prize; if he submits two or three models they will be considered jointly.

Your name and address must appear on the back of each photograph or sheet of paper used, together with your age, name of the competition ("May" Model-building Competition) and the Section in which the model is entered. Address the envelope "May" Model Competition, Meccano Ltd., Binns Road, Liverpool.

Entries for Sections A and B must be received by 30th June, 1928. Closing date for Section C: 29th September.

THE PRIZES

The Prizes to be awarded in Sections A and C are as follows:—

First Prize: Cheque for three guineas.

Second Prize: Cheque for two guineas.

Third Prize: Cheque for one guinea.

Six prizes, each consisting of Meccano Double Headphones, complete with head-band and flex.

Twelve prizes, each consisting of a Meccano Single Telephone Receiver.

The Prizes in Section B are as follows:—

First Prize, Meccano products to value two guineas.

Second Prize: Meccano products to value one guinea.

Third Prize: Meccano Double Headphones.

Six Prizes, each consisting of a Meccano Single Telephone Receiver.

Twelve Prizes, each consisting of a Complete Instructions Manual.

A limited number of Certificates of Merit and complimentary copies of "Meccano Standard Mechanisms" Manuals will be awarded in each Section.



Every keen Meccano boy who has not already secured a copy of the Meccano Book of New Models should do so at once while supplies are available. Our stocks of the second edition of the book are being rapidly absorbed, owing to the extraordinary demand, and it is doubtful whether we shall print a third edition.

For those boys who are not familiar with the book it should be explained that nearly all the models, movements and new model-building ideas illustrated are the direct outcome of prize-winning entries in recent competitions. They cover a wide range of interesting subjects. The Meccano Book of New Models also contains details of the best of the suggestions and ideas that have been published in the *Meccano Magazine* during recent months.

Large numbers of suggestions and bright ideas for new Meccano improvements reach us every day from Meccano boys all over the world. It is the task of our model-building department to select the best of these and to improve them as much as possible so that thousands of Meccano boys may benefit by becoming acquainted with their fellow-enthusiasts' work.

It should be understood that this book is entirely supplementary to the ordinary Instruction Manuals, and many of the models illustrated are published for the first time.

Order Your Copy Now

You may obtain a copy of the new book from your Meccano dealer, price 6d. If you have any difficulty send 7d. in stamps to us and we shall arrange to forward a copy to you immediately, post free. Address your letter as follows: "New Model Book," Meccano Ltd., Binns Road, Liverpool.

If you have a Meccano Outfit the book of new models will enable you to obtain increased pleasure from it and you will spend many happy hours building the new models and movements that are shown. There are models of various types of Cranes, a Mechanical Shovel, a Horizontal Engine, a Biplane, an Electric Elevator, a Pit Head Gear and many others, equally interesting.

The book is composed of 24 pages contained in an attractively coloured cover on which there is a fine illustration of a super Meccano model—the Block Setting Crane.

Orders from Overseas

There is a special edition of the "Meccano Book of New Models" for Overseas. This is now ready and supplies are being sent to our agents for distribution. The price Overseas is 9d., or 10d. post free (Canada 15 cents or 17 cents post free). Readers in Australia, New Zealand, South Africa or Canada who require copies should address their orders to our agencies as detailed below.

Readers living in countries other than those mentioned should order from Meccano Ltd., Binns Road, Liverpool, sending a remittance for 10d. with their order.

AUSTRALIA.—E. G. Page & Co., 52, Clarence Street, Sydney. (P.O. Box 1832).

NEW ZEALAND.—Models Ltd., Kingston Street, Auckland. (P.O. Box 129).

SOUTH AFRICA.—Arthur E. Harris, 142, Market Street, Johannesburg. (P.O. Box 1199).

CANADA.—Meccano Ltd., 45, Colborne St., Toronto.

SEND FOR YOUR COPY TO-DAY!

Competition Page

The World's Fastest Car: Drawing Contest

Since the winning of the Schneider Trophy by the Supermarine-Napier monoplane at the Lido in September last, no event has stirred the imagination of British boys more than Captain Malcolm Campbell's record-breaking motor dash on the sands of Daytona Beach on 16th February.

The interest, in fact, is so great that we feel sure that a drawing contest, with Captain Campbell's car as the subject, will prove especially popular. It is very unlikely that many of our readers will have seen the actual car but the several excellent photographs that have been published in the newspapers will prove useful guides. Readers who wish to do so, may use the picture, autographed by Captain Campbell, that appears with our article on page 416. Intending competitors are reminded that their entries need not be confined to black and white drawings. Colours may be used if desired.

It is a curious coincidence, by the way, that our last drawing contest had the Supermarine-Napier monoplane that won the Schneider Trophy for its subject. The engine of Captain Campbell's car is very similar to those used in the Schneider Trophy machines.

Prizes of drawing or painting materials, to be chosen by the winners, to the value of £1/1/– and 10/6 respectively, will be awarded to the first and second prize winners in each of the usual two sections, A for those aged 16 and over, B for those under 16. If preferred, the winners may choose Meccano products for their prizes. There will also be a number of consolation prizes.

Entries must be addressed to "25th Drawing Contest, Meccano Magazine, Binns Road, Liverpool," and must reach this office not later than 31st May. Overseas closing date 31st August.

Competitors who propose to submit more than one drawing are reminded that the name, age, and address of the entrant must be given on the back of each entry.

THE MYSTERY STORY CONTEST: JACK'S ADVENTURE

Lack of space has prevented us from publishing earlier the continuation of the mystery story, the first episodes of which appeared for competition purposes in our July issue last year. The results of the Overseas contest appear on page 445 but the winners have already been advised of their success. For the benefit of new readers we give a brief synopsis of the first incidents.

Jack, the hero of the story, much against his will, was sent by his mother on a shopping expedition. On his way he visited a railway station—and disappeared! What happened to Jack?

That was the problem set to our readers. Here is the solution.

* * * *

Running swiftly down the steps leading to the platforms, Jack slipped into a crowd filing past the ticket-collectors and, unobserved, passed the barrier. A fussy little 0–6–0 tank at the head of a local train quickly claimed his attention, but time was too short for a detailed inspection. As he vainly endeavoured to catch the driver's eye, a whistle shrilled, doors banged and to the accompaniment of much puffing and grinding, the "local" drew out of the station.

For the moment the station was clear of traffic. "I'd better take a look round at the advertisements and try to remember what I have been sent to buy," said Jack to himself. "Vim? No, that was'nt it! Bovril? No. Wolsey Underwear? Cadbury's Chocolate? Player's Cigarettes? No, it is not one of those. Palethorpe's Sausages? Chivers Jellies? Colman's Mustard? Robin Starch? Um. Now—"

Just as an idea flashed into Jack's mind, there was a sudden roar and clatter and bustle. The whole station seemed to wake into life in an instant. "Hurrah!" cried Jack, all thought of household commodities vanishing as he spotted "*Royal Scot*" itself at the head of the great express that had drawn up at a nearby platform.

The "*Royal Scot*"! What luck! Away dashed Jack, over the footbridge, down the steps, along the platform, until breathless with excitement, he drew alongside the footplate of the giant engine. "Hullo, sonny, what's all the hurry?" asked a deep voice that seemed to come from the clouds. Jack looked up. There, towering above him, was a big well-set man in grimy blue overalls, his eyes twinkling as he beheld the youngster's obvious excitement. "Like to come up, sonny?"

Jack's eyes nearly started from his head! He hardly dared believe his ears. Mount the footplate of the "*Royal Scot*"!

Like an arrow from a bow he bounded into the cab and then followed the most thrilling two minutes of his young life. Questions poured from his tongue like bullets from a machine gun as he moved rapidly around the cab touching one "gadget" after the other. So absorbed was he that it seemed only a second or two before the big voice broke in: "Well, sonny, we're signalled out. Perhaps we'll meet again. Goodbye!" And Jack was back on the platform again watching the tail of the long train swing away down the track.

He had been on the "*Royal Scot*"! What was shopping to interfere with such a thrill? Shopping was forgotten as he walked quickly along the platform bound for home to tell Mother all about his great adventure.

Suddenly Jack stopped short by a ladder that led up to a small door in the face of the great station clock. "Well, I'm hanged," he muttered. "I never knew that clock opened. I wonder what it's like inside?" And without further thought, up the ladder he went. It was a gloomy-looking cavern into which he peeped. At first he could see nothing, but as his eyes grew accustomed to the gloom, he noticed a little ladder leading into the upper portion of the clock. By now caution had been thrown to the winds; in he went and up the ladder.

For several minutes he gazed around, fascinated, at the queer forest of wheels, and then he was suddenly brought back to his surroundings by the sound of voices below. "It's nearly five o'clock, Jim. Shut that trap and put the ladder away. We'll finish the job to-morrow."

Terror-stricken, Jack hesitated just too long—and was a prisoner. As the full realisation of his awkward position came to him he shouted and shouted, but the hubbub of the station drowned his cries. After a while, worn out and thoroughly scared, he sank down into a space clear of wheels. For a long time he could not sleep, but gradually the whirring of the clockwork lulled him to sleep, to dream of the "*Royal Scot*" and huge revolving wheels.

He dreamed that he was riding a huge clock along the main line and was experiencing great difficulty in keeping on the track. Every quarter of a mile he found one of his smaller wheels out of true gauge and the cogs were tearing up the sleepers.

Horrors! There, rushing towards him was the "*Royal Scot*," and on the same track!

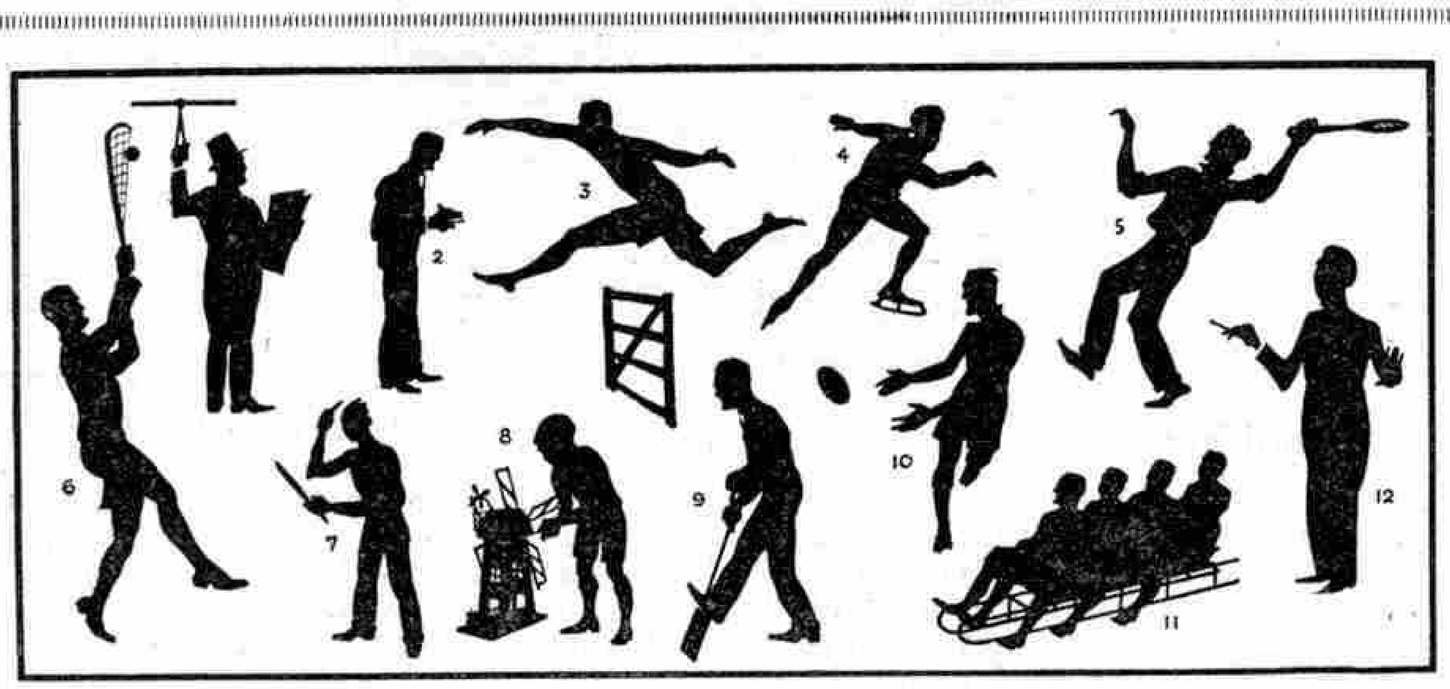
Jack shrieked to his driver friend, although it seemed useless. But no, he had heard. There was a great grinding of brakes, the shriek of a whistle, and the "*Royal Scot*" came to rest just as a buffer touched Jack's chest!

Jack woke with a start, to find the flap of the trap pressing lightly on him and to see staring down upon him the clock-cleaner, his face the picture of amazement!

In a flash it all came back, and Jack gasped out his story. As he went on, a grin gradually spread over the good-natured-looking face of the cleaner. "By Jove, sonny," he said "you haven't half had an adventure," and Jack did not feel at all inclined to dispute the fact!

Down the ladder went Jack and made his way slowly homeward. "Goodness!" he thought, "what a row there will be!" There was, but his father and mother were far too much relieved to see him safely home again to adopt drastic measures.

Jack has met his "*Royal Scot*" driver friend on several occasions since then, but he has no desire to make any further acquaintance with the internal affairs of station clocks!



Competitors in the Silhouettes No. 1 Contest, the Overseas result of which was published last month, will be interested to see the solution given above. It will be remembered that competitors were asked to identify the actions of the figures after the "clue" portions had been deleted. The actions are as follows:—1. Strap hanging. 2. Snapshotting. 3. Hurdling. 4. Skating. 5. Tennis. 6. Lacrosse. 7. Brushing hair. 8. Model-building. 9. Digging. 10. Rugby football. 11. Sledding. 12. Conducting.

OBJECTS of the GUILD

To make every boy's life brighter and happier.

To foster clean-mindedness, truthfulness, ambition and initiative in boys.

To encourage boys in the pursuit of their studies and hobbies, and especially in the development of their knowledge of mechanical and engineering principles.

The Meccano Guild

With the Secretary

Summer Camping Grounds

The number of Meccano clubs that hold a camp regularly every summer has increased steadily during the past few years and everything points to a record number this summer. Several Leaders have written to ask my advice in regard to the choice of a suitable site for a camp. At one time this used to be a serious problem, because it was very difficult to obtain any information at all regarding suitable sites except those in one's immediate district.

The railway companies have recently done a great deal to improve this state of affairs. I have just received from the Great Western Railway Company, for instance, an illustrated booklet which gives a list of suitable sites throughout the whole of the area served by this railway. In the case of each site the name and address of the owner or tenant is given, together with sufficient information to enable a club Leader to decide whether this particular place would be suitable or not. The amount of land available is given, the nature of the surrounding country is indicated and, in addition, an important point that is easily overlooked—the whereabouts of the nearest drinking-water supply. Application to the Superintendent of the Line at Paddington Station will bring this useful publication by return of post.

Similar lists are issued by the L.N.E. and the L.M.S. Railways. The Southern Railway do not issue a special booklet, but include some valuable hints in a general publication entitled "*Hints for Holidays*," the cost of which is sixpence.

Many important concessions are made by the companies in regard to fares for camping parties. The G.W.R. for example, issue return tickets at single fare to members of organised parties, with a charge of half single fare in the case of those under 16. Such a concession makes it possible for a club to select a camping ground much further afield than could be done if full fare had to be paid, and I advise Leaders to keep this in mind when plans are being made.

Meccano Club Secretaries

No. 12. J. Maling



John Maling has been secretary of the Diss Church Meccano Club from its commencement, and its successful progress has been due very largely to his untiring and infectious enthusiasm. Lectures and model-building are the most popular features of the syllabus, and the club has been particularly successful in the socials that have been held from time to time.

Camp Cooking

Cooking in a camp is rather a nuisance, but it has to be done somehow and by somebody. Not only this, but if the camp is to be a success the cooking must be done well. The meals need not be at all elaborate, but there must be available an ample quantity of good, substantial, well-cooked food. In many cases it so happens that those who undertake the cooking at a particular camp have had no previous experience, and the result is now and then the production of some really startling dishes! At the same time, the task is by no means difficult, provided one has a little help in the early stages. In this connection I can thoroughly recommend a book entitled "*Camp Cooking and Catering*" by Major J. T. Gorman. In this book the author shows how to plan meals for any number of persons in the most economical way, and gives some very useful advice and recipes for easily prepared yet satisfactory dishes. He also includes some really valuable hints on equipment and methods, and if these are carefully followed there should be little difficulty in making a success of the very first meal. The book is published by Brown, Son and Ferguson Ltd. of Glasgow, and its price is 2/6 net.

Club Photographs

The photograph reproduced this month on the "*Club Notes*" page is one of the most interesting that I have received for a long time in regard to showing the actual home of a Meccano Club as it appears during club meetings. The only criticism I have to make is that the photograph would have been more interesting if it had shown the members at work. I should very much like other clubs to take this photograph as an example and send me as good a photograph as they can obtain of their meeting room in working order. Photographs of this nature are of particularly great interest to new clubs that have not yet definitely settled down and therefore are glad of any hints.

While on this subject of photography I hope that Leaders will do better this year in the way of sending me photographs of camps, excursions or outdoor events of any kind, not overlooking any humorous incidents that may occur. I am convinced that it is in the interest of Leaders to encourage club photography. Every club includes at least one member who possesses a camera and is fairly expert in the use of it. If this member is appointed official photographer to the club he will, as a rule, be quite keen on making an interesting collection of photographs, and his expenses are easily covered by the sale of prints at a small charge to the members who appear in the photographs. By adopting this plan, a complete pictorial record of the summer session is obtained, in which every member may be represented.

Proposed Clubs

Attempts are being made to form Meccano Clubs in the following places, and boys interested in becoming members should communicate with the promoters, whose names and addresses are given :—

KENILWORTH.—L. Wilson, St. Elmo, 8, Abbey End, Kenilworth.

KINGSTEIGNTON.—H. H. T. Campion, 2, Hayes Terrace, Kingsteignton, Devon.

LIVERPOOL.—F. Stockley, 20, Hawkins Street, Kensington, Liverpool.

LONDON.—H. Gray, 80, Forest Hill Road, East Dulwich, London, S.E.22.

LOWESTOFT.—E. G. Foreman, 54, St. Leonards Road, South Lowestoft.

OTTRINGHAM.—George Billaney, Nursery Garth, Ottringham, nr. Hull.



CLUB NOTES



Links Boys' M.C.—Table Tennis equipment and a set of Draughts have been purchased and Tournaments in both games are being arranged. A Lending Library has been started and is proving quite popular. The programme includes Competitions of various kinds, Model-building, Lantern Lectures, Fretwork, Railway Nights and Boxing. Club roll: 43. *Secretary*: N. Donaldson, 38, Eastbourne Road, Tooting, S.W.17.

Galashiels M.C.—Debates continue to be popular among the members. An interesting Model-building competition has now concluded, for which valuable prizes of Meccano goods were given by the local dealer. Many excellent Models were displayed on the occasion of a Visitors' Night. An interesting feature of the club's activities is cigarette card collecting. Two sets entitled "*Engineering Wonders*" are to be collected and pasted into a book. Club roll: 18. *Secretary*: David Richmond, 38, St. John Street, Galashiels.

Albert Village M.C.—A Lecture on "*Electricity*" by Mr. G. Nickolls and chemical demonstrations by Mr. H. R. Tunnicliffe were great attractions, and a Chemical Section has been formed as a result of the latter. Model-building Contests, Hornby Train Nights and Games Tournaments have been organised, while preparations are now being made for an Exhibition. Club roll: 18. *Secretary*: L. C. Adey, 239, Occupation Road, Woodville, Burton-on-Trent.

Winchmore Hill Collegiate Schools M.C. — Recent features have been lectures on "*Bridges*" and the "*Tower of London*" given respectively by the Leader and the Vice-President. Hornby Railway and Model-building Nights continue in favour and a particularly enjoyable evening was spent with a large Model loaned from Headquarters. A Lantern Lecture loaned by the De Havilland Aircraft Company was also another noteworthy feature. The Annual Exhibition was a great success and the many Models exhibited showed a high standard of inventiveness. The Stamp Section is making steady progress. Club roll: 40. *Secretary*: K. Walden, 18, Old Park Road, Palmers Green, London, N.13.

Withington Kim M.C.—One of the most interesting visits in recent months was to Victoria Station to inspect the "*Royal Scot.*" Members were greatly impressed by the huge size of this fine engine and after examining it as closely as time permitted, walked round the station and compared it with other engines drawn up at the various platforms. It was decided that a comparison of this kind afforded the best means of realising the huge dimensions of the "*Royal Scot.*" Lectures, Hornby Train Evenings and Meccano Evenings are the main features of the syllabus. Club roll: 11. *Secretary*: C. E. Ball, 45, Davenport Avenue, Withington, Manchester.

Withington M.C.—A recent Contractors' Night proved a great success. Two contractors were chosen and each provided with a "Gang," with the object of drawing up plans for the construction of a Railway Breakdown Crane. The better of the two plans was chosen by the Leader and the gang concerned then built their Model while the others played games. An interesting Lecture on "*Transport*" was delivered by the Leader, the slides being kindly lent by Cadbury Bros. Ltd. Future arrangements include Model-building, more Contractors' Nights, Stamp Nights and the always popular Do-as-you-like Nights. Club roll: 12. *Secretary*: K. Cradduck, 36, Mauldeth Road West, Withington, Manchester.

Westbury M.C.—A lecture loaned from the De Havilland Aircraft Company was delivered by Mr. Knowles of the Royal Air Force, whose technical knowledge added greatly to the interest of the splendid slides. Model-building Competitions have been a special feature of the past session, the prizes being awarded on the work of the whole session. A Contractors' Night proved specially attractive. Club roll: 30. *Secretary*: Eric D. Moye, 24, Burnell Rise, Letchworth, Herts.

Rhos-on-Sea M.C.—Cycling is a popular feature of this club and a sand cycle race provided much excitement, G. E. Mellor coming in first. A Model Railway Section has been formed, while a particularly interesting feature of this club is a Miniature Nation Section, the members of which build miniature houses and shops, lorries, motor buses, etc., on a scale of 5 m.m. to 1 ft. About 100 model people have been "built" to inhabit the 20 to 30 houses already erected. Club roll: 12. *Secretary*: G. E. Mellor, "Bradda," Allanson Road, Rhos-on-Sea, Colwyn Bay.

Buckhurst Hill M.C.—An Exhibition recently organised attracted a large number of parents and friends. Among many excellent models displayed were a Horizontal Engine, Meccanograph, several Cranes, and a Dutch Windmill, while signals and a footbridge were constructed by one member for use in conjunction with the Model Railway. The visitors were greatly interested in the latter, eagerly assisting to replace the trains when they came off the rails. Club roll: 8. *Secretary*: D. Mason, Lyndale, Palmerston Road, Buckhurst Hill, Essex.

Willingham M.C.—The Rev. A. C. Hair, the President, has given several very enjoyable lectures to the club. The members have arranged to bring their fretwork outfits to the club and are hoping to make a good show in this interesting hobby at the forthcoming Exhibition. Club roll: 15. *Secretary*: A. J. Huckell, Short Lane, Willingham, Cambs.

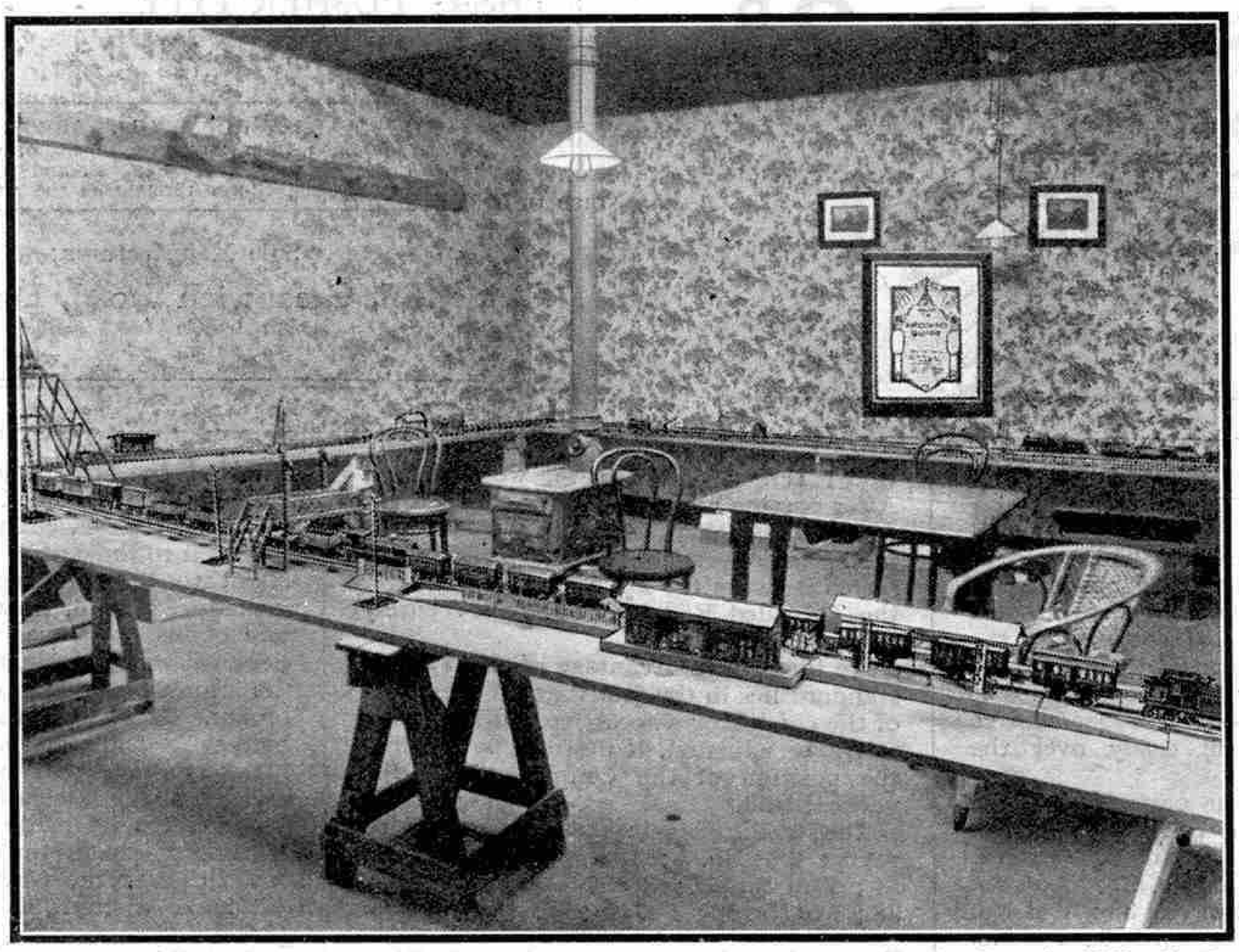
Hessle M.C.—Now possesses a fine cinematograph and some excellent films and slides have been shown. Model-building Competitions are arranged regularly and the entries submitted are always of a very high standard. The splendid Library is well patronised, while the Stamp Section is making good progress. Club roll: 17. *Secretary*: T. A. Fillingham, "Red Lea," Marlborough Avenue, Hessle.

Loanhead M.C.—A lantern lecture entitled "*English Lakeland*" was given by the secretary, the slides being supplied by the London, Midland & Scottish Railway. Another interesting lecture entitled "*A Trip to Dublin and the Lakes of Killarney*" was also greatly enjoyed. The club Social and Concert held recently was a great success, and preparations are now being made for an Exhibition. Club roll: 28. *Secretary*: Bertie Warnock, R.P. Manse, Loanhead, Midlothian.

St. Albans M.C.—Has been very fortunate in securing the Rev. Canon H. A. Skelton, M.A., the Sub-Deacon of St. Albans Cathedral, as President of the club. The members have now been divided into four sections known as Nuts, Bolts, Spanners and Screwdrivers. Each section is in charge of a member of the committee, and there is keen competition among them. Club roll: 24. *Secretary*: A. H. Powell, 5, Alma Road, St. Albans, Herts.

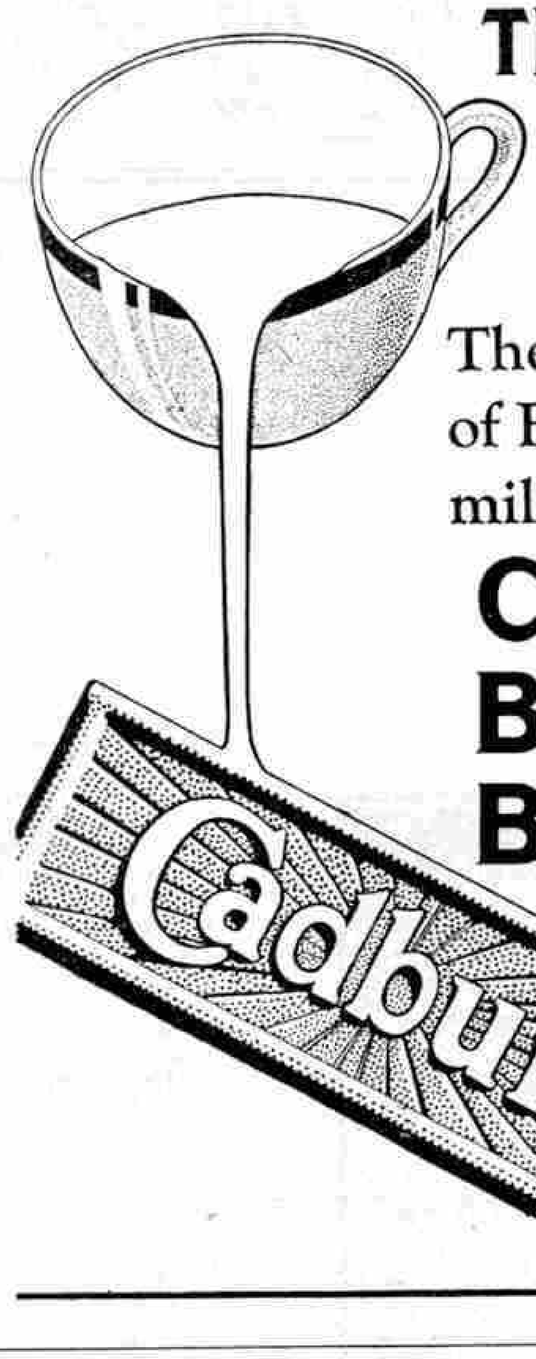
Elm Road M.C.—Wireless is a popular feature of this club and the members take a practical interest in demonstrations of the methods of constructing receiving sets. Model-building is also greatly in favour, all models constructed being original. Games of a competitive nature are arranged regularly one that proved interesting testing the members knowledge of abbreviations such as R.N.A.F. and A.M.I.E.E. Club roll: 20. *Secretary*: C. W. Price, 50, Queens Road, Beckenham, Kent.

Larne Meccano Club



Our photograph shows the meeting room of the Larne Meccano Club. This club was affiliated in December 1927 under the Leadership of Dr. Thos. Killen, and in spite of its comparative youth it has made rapid progress, largely on account of the sound lines upon which it has been guided by its Leader. The main interests of the members are Meccano and miniature railways, as may be judged from the photograph.

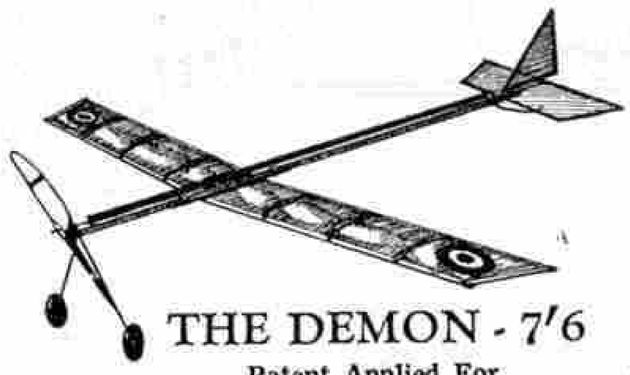
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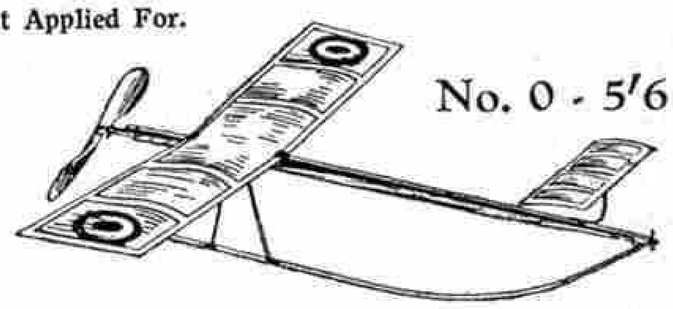


THE DEMON - 7'6

Patent Applied For.

THE 7/6 and 10/6 "TRACTOR" MACHINES are fitted with a combination swivel double bearing and shock-absorbing chassis. This invention gives the propeller a 50% advantage over other Tractor Models regarding breakages.

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TRADE ONLY. LEAFLETS FREE.

Electricity Applied to Meccano

(*Continued from page* 431)

When the wire has been placed in position it should be clamped tightly between the 3" Strips by screwing up the centre nut and bolt. This method of attaching the overhead wire to the standard will be found perfectly satisfactory in operation, for it allows the collector bow of the locomotive to pass smoothly and easily over the connection.

The following are the parts required to build the standard shown in Fig. 4: 2 of No. 1; 1 of No. 3; 2 of No. 4; 2 of No. 10; 1 of No. 11; 1 of No. 12; 2 of No. 12a; 10 of No. 37; 2 of No. 38; 1 of No. 108; 1 of No. 302; 1 of No. 303; 1 of No. 304; 1 of No 305.

Another type of Single Wire Standard

The third type of standard (Fig. 5) is designed principally for use in connection with the tramcar type of collector, which consists of a small pulley mounted at the end of a spring-controlled trolley arm, which presses against the overhead wire. (It will be noticed that the supports for the overhead wire in the two previous examples would not permit the trolley pulley to pass smoothly over the connection).

The wire connecting piece is of similar construction to that employed in Fig. 4, except that it consists of two $2\frac{1}{2}$" Strips instead of two 3" Strips. The $3\frac{1}{2}$" Threaded Rod 1, which supports the wire connecting piece, is secured in a Coupling 2 attached to an $11\frac{1}{2}$" vertical Rod. The latter is secured rigidly in the boss of a Bush Wheel that is screwed down to the wooden base. After passing along the lower edges of the two Flat Brackets in the wire connecting piece, the electric conductor wire is inserted between the $2\frac{1}{2}$" Strips and led over the Threaded Rod 1. It is then securely clamped in position.

An important advantage of this type of standard lies in the fact that the elevation of the conductor wire above rail level may easily be adjusted, if desired, by altering the position of the Coupling 2 on the vertical Rod.

The standard is composed of the following parts: 2 of No. 5; 1 of No. 13; 1 of No. 24; 2 of No. 37; 2 of No. 37a; 2 of No. 38; 1 of No. 59; 1 of No. 63; 1 of No. 80a.

Famous Inventions—(*continued from page* 374)

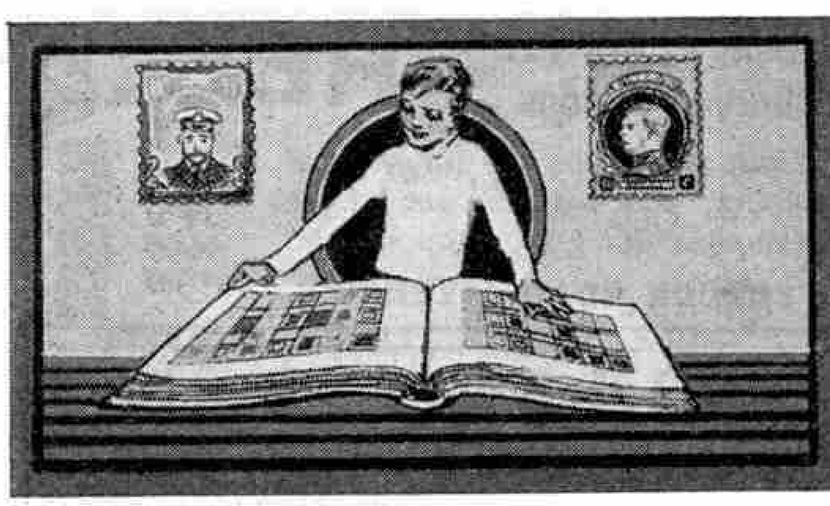
of the country in order to find out the extent to which his invention had been adopted. He found that while 156,000 spindles were being worked by means of Hargreaves' spinning jenny, and 311,000 spindles by means of Arkwright's invention, 4,650,000 spindles were in operation on his mules. During this tour Crompton visited Glasgow where the spinning mule had been adopted very extensively and with great profit to the manufacturers. A few of the millowners learned of his presence in the city and organised a public dinner in his honour, but this belated recognition was too much for Crompton and he did not attend. "I first hid myself," he related afterwards, "and then fairly bolted from the city!"

At the conclusion of his tour Crompton embodied the statistics he had obtained in a claim that he submitted to the Government in 1812. His application was favourably received by Mr. Spencer Perceval, then Prime Minister, and Crompton began to hope that the service the spinning mule had rendered to the cotton industry was at last about to be recognised. Once more ill-luck dogged him, however, for while the fate of his claim was still in the balance Perceval was assassinated in the Lobby of the House of Commons by a bankrupt broker. It is said that at the time of Perceval's death his portfolio contained a paper showing that he had intended to urge the House to award Crompton £20,000. The claim fared badly without the Prime Minister's influence in its favour, however, and although the Government ultimately did make a grant, it amounted to only £5,000.

With this new capital Crompton entered the bleaching trade and later became a partner in a firm of spinners and weavers. He was very lacking in business knowledge and ability, however, and in spite of his efforts he was unsuccessful and once more became reduced to poverty. His continued misfortune aroused the sympathy of some of his friends and between them they bought him, in 1824, an annuity of £63, and on this meagre income Crompton lived up to his death on 26th June, 1827.

STAMP PERFORATION GAUGE

If you are a stamp collector you should make a point of securing one of these Perforation Gauges, which enables you to find the size of perforation of any stamp quite easily. The price of the Gauge is 1d. post free, from the Editor, "*M.M.*"



Stamp Collecting

SPORTS STAMPS

IT is an interesting fact that in spite of the great part that athletic sports play in the daily life of nations, they have rarely been featured on stamps. We can call to mind only three catalogued instances where sports have provided the theme of a stamp issue. Two of these, the Greek issue of 1906 and the French issue of 1924, were associated with the quadriennial Olympic Games. Neither depicts modern sports. The Greek designs show the ancient gods at play and early Greek athletes, while the French issue is chiefly concerned with allegorical pictures of "youth" with Parisian "show spots" in the background, although the best stamp of the set, the 30c., shows Atlas, the Greek god, splitting a great log with his bare hands.



The third sports issue came from Hungary in 1925. In this series there were eight values and designs, each taking a modern sport for its theme. Thus we find a ski-ing scene on the 200 kr.; Skating, 300 kr.; Diving, Swimming and Rowing, 400 kr.; Fencing, 500 kr.; Scouts, 1,000 kr.; Football, 2,000 kr.; and Hurdling, 2,500 kr. Although this issue in general had no connection with Olympic Games, the 100 kr. design, illustrated here, links up the subject. The design represents a band of athletes marching past a grandstand prior to the contests. The march past of the nations taking part is one of the most striking scenes in the Olympic Games festival. Each of these stamps was sold at twice its face value, the surplus funds being devoted to various Hungarian sports associations. A specially interesting feature of this issue is the inscription on the back of the stamps explaining the object of the issue.



A fourth sports issue recently made its appearance in Holland. This is to commemorate the ninth series of Olympic Games that are to be held at Amsterdam in August next. Our readers will be particularly interested to see the reproduction of the designs that are published on this page. Unfortunately specimens of the actual stamps were not available at the time this issue went to press. Certain of the designs, notably the 5c., 7½c. and 15c. values, strike an entirely new note and are very effectively produced. We confess to a feeling of disappointment, however, with other of the designs. The 10c. and 30c. are a long way behind the standard of draughtsmanship that one has learned to expect from Holland.



The Marathon runner of the 10c. stamp, though free in his action, does not look the type, for there is a weediness of build that suggests lack of stamina. The design of the 30c. stamp is even more at fault. The picture here is of a typical old-time prize-fighter—in association with Olympic amateur sport! Furthermore, although one cannot see his opponent, one suspects that this boxer already has received his "*coup de grace.*"

Like the Hungarian sports issue, the new Dutch stamps are to be sold at a premium. The additional funds, in this case, will be used to defray the expenses of the Netherlands Olympic Games Committee. The actual selling values are 2½c. (1½c. dark green), 3c. (2c. violet), 4c. (3c. light green), 6c. (5c. light blue), 10c. (7½c. orange yellow), 12c. (10c. red), 17c. (15c. dark blue), 33c. (30c. brown). For reference purposes the face values and the colours of the respective designs are given in parentheses.



Through the courtesy of the Editor of the "Nieuwe Rotterdamsche Courant" (Holland) we reproduce above the designs of the new Netherlands Olympic Games issue

The fact that three of the four issues of sports stamps owe their origin to the Olympic Games Festivals directs our attention particularly to these notable international events. It will be observed that one of the labels on the 10c. French stamp illustrated is worded "*VIIIe Olympiade.*" Lest there be any misapprehension, the word is not French for Olympic Games. It is the name given to the period of four years intervening between each set of games, and in earlier times the succeeding Olympiads were the accepted method of reckoning time in Greece. (*Continued on page* 445)

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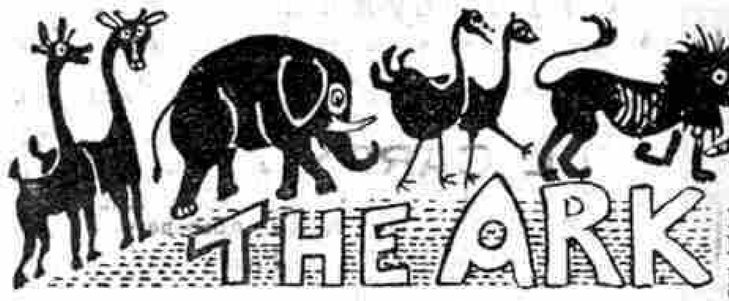
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Stamp Collections, etc., purchased.



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H. C. WATKINS (M. DEPT.), GRANVILLE ROAD, BARNET

Stamp Advertisements continued on page 456

Stamp Collecting—*(continued from page 443)*

The games themselves are of mythical origin. In Greek records, the gods of Mount Olympus—Atlas, Hercules, Apollo—all of whom were mentioned in our article dealing with the gods and goddesses of Ancient Greece (April, 1927, issue), are reputed to have taken part, and most of the designs of the Greek Olympic Games issue took their themes from statuary depicting the gods at play. Thus, on the 1 lepton value illustrated, Apollo is shown throwing the discus; the 5 lepta, also illustrated, shows Atlas performing a feat of strength, possibly in a weight-putting event; in the 25 lepta a great wrestling struggle between Hercules and Antæus is shown in progress. Other stamps of the issue have designs depicting incidents in the early games. For example, on the 1 drachma value, reproduced here, a group of runners in the great Marathon race is shown.



No Olympic event stirs public imagination like the Marathon race. It is the greatest athletic endurance test, for the runners are required to cover a distance of 26⅜ miles. The first 26 miles are run over public roads, and the final third of a mile consists of one lap of the track in the games area itself.



The earliest authentic record of the holding of the games at Olympia, the ancient Greek gymnasium and religious centre, dates back to 776 B.C., when one Coroebus was crowned victor. It is stated, however, that the Emperor Iphitus of Elis, reorganised the festival in the ninth century, B.C. From 776 to 728 there was only one big competitive event, a 200 yards foot race. As time passed other events were added until, by the time the fourth century A.D. was reached, a big programme had been built up. In modern times, in addition to the old events, we have an enormously expanded programme that includes tennis, football, motor racing, motor boat racing, water polo, horse racing, ice skating and almost every other phase of modern sport.



In those early days, even as to-day, the intrinsic value of an Olympic award was nothing—a wreath of laurel or a sprig of olive from the groves of Mount Olympus; but the glory of the victory so greatly reflected on the victor's city that he was granted substantial municipal privileges. In the earliest times the victor was regarded as an incarnate god; he was regally feasted, clothed in purple robes and generally regarded as the "King" of his district. He was required to defend his title against all comers, and reigned until he was defeated.

The celebration of the festival died out in the fourth century and remained neglected until 1896, when a brilliant revival was carried through at Athens, the ancient Stadium being specially restored for the purpose. Subsequently the games have been held every four years in various parts of the world, until we come to the series shortly to be held in Amsterdam.

It is natural that contests with so great a history should attract the interest of every sporting nation throughout the world. Consequently at Amsterdam in August there will be gathered the cream of the world's athletic forces, ready to do battle for the honour of their countries. Each of these athletes is an amateur, playing his games for the pure joy of the sport. As we have stated in an earlier paragraph, the only reward the successful athletes enjoy is the honour of victory and perhaps a sprig of laurel.

In this connection it is interesting to relate that at the Olympic Games held in London in 1908, each victor was presented by the late King Edward VII with a sprig of oak cut from trees in the Royal Parks at Windsor.

Behind this story of sport for sport's sake there is a moral that can be adapted to every hobby and especially stamp-collecting. Collect stamps for the love of stamps and their message. The mere joy of acquisition—admittedly at the base of all forms of collecting—is, of itself, transitory and very soon fades into insignificance behind the much higher ideals of our hobby.

We are indebted to Stanley Gibbons Limited for their courtesy in loaning the stamps for reproduction with this article.

Stamp Gossip

A U.S. Thirteen Cent Stamp

A reader wrote to us recently on a question of superstitions. Dealing with the abhorrence displayed toward the figure 13, he commented: "Now the U.S. Government is not superstitious; it has a 13c. stamp."

America is not alone in issuing a 13c. stamp, but our reader's remark calls to mind an interesting story involving a unique run of the figure 13, relating to the withdrawal of the original 13c. stamp in 1921. A petition protesting against this withdrawal was sent to the United States Postal Authorities by a band of enthusiastic stamp collectors. The following were the reasons why the stamp ought to be retained:—

1. America was discovered on the eve of the 13th of the month.
2. The original republic consisted of 13 colonies.
3. The first official flag had 13 stripes and 13 stars.
4. The American national emblem, the American eagle, required 13 letters to spell its name, as does also the motto "E pluribus unum."
5. The first word sent over the American cable was sent on the 13th day of the month.
6. The silver quarter-dollar is written all over with 13. The eagle has 13 leaves in one claw and 13 thunderbolts in the other. On its breast is a shield bearing 13 bars. Hanging from its beak is a ribbon bearing the motto with its 13 letters. Each wing has 13 feathers. It takes 13 letters to spell "quarter-dollar."
7. There are 13 letters in the name of John Paul Jones, the famous American.
8. There were 13 ships in the first American navy.
9. Parry's victory on Lake Erie was won on the 13th day of the mouth.
10. The Stars and Stripes were raised on Fort Sumter on the 13th day of the month.
11. General Pershing reached France on 13th June, 1927.
12. The 13th amendment of the American constitution freed the country of slavery.

Obviously, in support of such a petition a 13th reason had to be given. It was that the printing of a 13c. stamp would cost no more than any other!

Regardless of these interesting reasons, the 13c. stamp was discontinued.

COMPETITION RESULTS

Critics' Letter Contest.—A pleasing feature of this contest was the free and easy style in which the majority of the letters were couched. There was a marked absence of grand sounding phrases. As a result the bulk of the entrants were able to let themselves go and many helpful and interesting criticisms and suggestions were forthcoming.

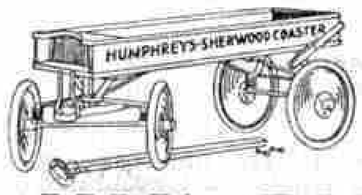
Obviously there has not been time to examine the possibilities of all the suggestions made, but careful consideration will be given to each. Possibly an opportunity will arise later to discuss several of the more important but that must be deferred until our Overseas readers' suggestions have been received.

The names of the prize-winners are as follows:—First Prizes: Section A, F. W. SKINNER (Flowerdown, Winchester); Section B, J. R. PLENDERLEITH (East Sheen, S.W.14). Second Prizes: Section A, S. T. WILLS (Stoke, Devonport); Section B, R. H. ALDRIDGE (St. Neots, Hunts.). Consolation Prizes: R. F. MOORE (New Malden); R. WOOD (Gorton, Manchester).

Cover Voting Competition.—1. G. S. MARSH (Blackpool); 2. W. E. PIKE (St. Thomas, Exeter); A. REALEY (Sandown, I.W.); 4. V. MCGANN (Fermoy, Co. Cork). Consolation Prizes: A. COWGILL (Rossendale); S. H. DAWSON (North Shields); L. F. GILBERT (Portsmouth); E. J. L. GRIFFITH (Rugby); H. G. HOLMES (Brighouse, Yorks.); I. L. MASON (Ashby-de-la-Zouch); J. SHERMAN (Belfast); S. THOMSON (London, N.W.5).

OVERSEAS RESULTS

Jack's Adventures.—First Prize: N. SCOTT (Winnipeg, Manitoba, Canada); Second: H. TEMPLE HATCH (Three River, Quebec); Third: E. HOLDER (Trinidad, B.W.I.); Fourth: MAXWELL GAGE (Auckland, N.Z.). Consolation Prize: D. MARSH (Cape Town, S.A.).



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WILL CARRY A TON

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THE MASTERPIECE

Three American artists were telling tall stories of their work.

"The other day," said one, "I painted a little deal board in imitation marble with such accuracy that on being thrown into the water it sank to the bottom."

"Go on!" said another, "Yesterday I hung a thermometer on the easel supporting my picture of the Polar region, and it fell at once to twenty degrees below zero."

"That is nothing," remarked the third artist. "My portrait of a prominent New York millionaire was so lifelike that it had to be shaved twice a week!"

* * * *

Mother: "But how did you get all that coal, Tommy. I hope you didn't steal it?"

Tommy: "No, mother. I just sat on the railway crossing, and made faces at the engine-drivers."

* * * *

SINGULAR

Canvasser: "Are you single?"

Man at the Door: "Yes."

Canvasser: "Why, the people next door told me you were married!"

Man at the Door: "So I am."

Canvasser: "Yet you told me just now you were single."

Man at the Door: "So I did."

Canvasser: "Well, what is the matter with you?"

Man at the Door: "Nothing. My name is Single, and I'm married. Good-day!"

* * * *

Bigbrain (rushing into library): "I want the life of Cæsar."

Librarian: "Sorry. You're too late. Brutus beat you!"

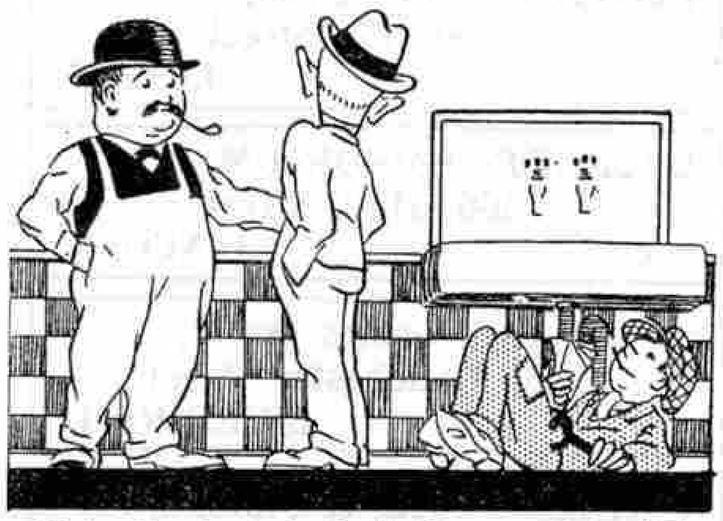
* * * *

Student: "How long could I live without brains, sir?"

Professor: "That remains to be seen!"

* * * *

TIME IS MONEY



Master Plumber (referring to his apprentice): "I've never see'd a bloke take so long over a job in my life. That lad'll go far!"

* * * *

"I 'ear Bill 'Awkins is suin' the company fer damages."

"Why, wot 'ave they done to 'im?"

"They blew the knockin-off whistle when 'e was carryin' a 'eavy bit o' wood an' 'e dropped it on 'is foot."

* * * *

What is invisible yet never out of sight?

The letter S.

* * * *

MUCH CHEAPER

"I say, waiter, here's half-a-crown!" said Jones, entering an expensive restaurant.

"Thank you, sir. I suppose you want me to reserve a table for you?"

"No, I don't; I shall come in here in about a minute's time with two ladies and I want you to tell me all the tables are engaged."

THE PAY'S THE THING

A troupe of Shakespearean actors of extremely uncertain financial standing were lounging in the lobby of a small town hotel. The manager entered and addressed the leading man of the company: "Don't forget. We're playing 'Hamlet' to-night," he announced.

"'Hamlet,' eh?" replied the actor. "All right, but I can't play Hamlet with this three-day beard. Gimme a shilling for a shave."

The manager reeled slightly. "A shilling! We'll play 'Macbeth.'"

* * * *

A GOOD OPENING

A chaplain was visiting a prisoner who was about to be discharged.

"What are you going to do when you come out?" he inquired.

"Open a jeweller's shop, guv'nor."

"That will need a lot of money, won't it?"

"Oh, no," said the convict, "only one-and-six for a jemmy!"

* * * *

DAMPING THEIR ARDOUR



First Countryman (on a visit to city, to driver of street watering-cart): "Hi, man, you're losing all your water!"

Second Countryman (contemptuously): "Hold your tongue, Tom. Don't you know it's let out to stop the boys from hanging on behind!"

* * * *

NO AIR LEFT

Tourist: "This place is famous for its air, is it not?"

Native: "Ay, it used ter be; but the motey-cars and motey-bikes pumps all the fresh air into their wheels and takes it away wiv 'em!"

* * * *

Headmaster: "Would you like your son to learn the dead languages?"

Mr. Barmy: "Certainly. He's going to be an undertaker."

* * * *

TOO LIGHT TO BE TAKEN SERIOUSLY

Magician: "Do you want to know a trick?"

Audience: "Yes."

Magician: "Well, take a bath in kerosene and light a match."

Member of the audience: "Where's the trick?"

Magician: "The trick is to light the second match."

* * * *

Doctor: "Now, take a deep breath, and say nine three times."

Smart Boy (after inhaling): "Twenty-seven."

* * * *

Medical Inspector: "What is the result when a patient's temperature goes down as low as it can?"

Student: "Why-er-he gets cold feet!"

* * * *

AT THE XMAS PARTY

Hostess: "Now Tommy, why don't you go and play with your little friends?"

Tommy: "I've only got one friend and I hate him!"

* * * *

The Boarder (angrily): "It's no good talking to me. I haven't lived in lodgings for years for nothing."

Landlady: "No, and you're not going to live here for nothing, neither."

ALL STAYING HOME

An American school teacher was trying to correct the English of one of his negro pupils. Hearing the boy say, "I gwine there," he told him that was not the way to talk.

"Listen—I am not going there; you are not going there; he, she or it is not going there; we are not going there; you are not going there; they are not going there. Do you get the idea?"

"Yes, sir," the boy assured him. "I get it all right. There ain't nobody gwine."

* * * *

A certain rich American was touring Ireland when he met Pat, who had a thick mop of hair. The American, who was completely bald, thinking he could make a joke at Pat, said, "I hear that hair and brains don't go well together, Pat!"

Pat replied, "But anybody knows that an empty barn requires no thatch."

* * * *

THE SONG OF THE FORD

There was a little man whose name was Henry Ford,
He took a bit of tin and a little bit of board,
A little drop of petrol and an old tin can,
He stuck the lot together and the darn thing ran!

* * * *

"I can truthfully say that none of my customers has ever complained of my work."

"What is your work?"

"I am a coffin maker."

* * * *

"Willie, dear, you are looking very unhappy," said his mother, "what's the matter? Willie, look up!"

"Dyspepsia and rheumatism," he said.

"Dyspepsia and rheumatism?" Don't be silly!" exclaimed mother.

"I'm not. Teacher kept me in all the afternoon because I couldn't spell them."

* * * *

LOWER MATHEMATICS

Teacher: "Tommy, what is one-half of one-tenth?"

Small Boy: "I don't know exactly, teacher, but it can't be very much."

* * * *

Little Willie (as turncock turns on water from the main): "Look, uncle! I s'pose the world wouldn't go round if that man forgot to wind it up."

* * * *

Old Salt: "Yes, guv'nor, I was shipwrecked and I lived for a week on a tin of sardines."

Cryptic Listener: "By Jove! Not much room to move about, what!"

* * * *

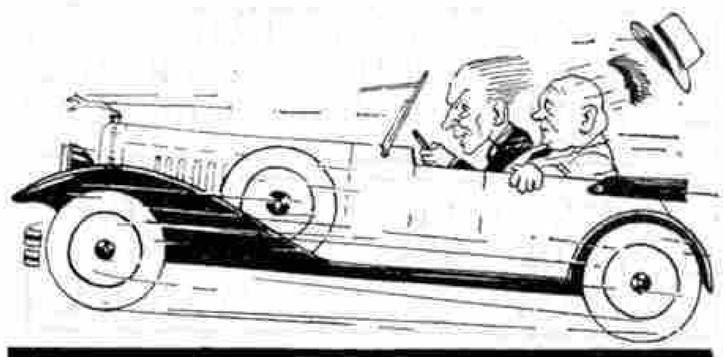
A business man calling on a Scottish broker in the City noticed that the slow, hesitating conversation for which Mac had been noted had disappeared.

"Why, Mack, you've lost your stutter," he exclaimed in amazement.

"Aye; I've been doin' a lot of telephonin' to America lately," was the dour reply.

* * * *

THE SPEED MERCHANT



Dazed Passenger: "Heavens, I've never been so fast in my life."

Celtic Friend: "Surely you don't call this fast. You ought to be with me when I'm by myself!"

* * * *

A warder was showing visitors over the prison.

"All the prisoners are washed on their arrival here," he explained.

"What if they make a fuss?" asked a woman.

"Then, madam," replied the warder, "they are ironed."

Meccano & Hornby Train Supplies

All the dealers whose advertisements appear on this page carry full stocks of Meccano Outfits, Accessory Outfits and Meccano parts, Hornby Trains and Hornby Train Accessories all the year round. The names are arranged in alphabetical order of town.

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Tel. 143

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Reliance Cycle & Motor Co.,
29/31, Manchester St., Liverpool.
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The ARUNDEL CYCLE & SPORTS STORE, 52, Church Road,
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DEMPSEY & CO.,
69, South Side, CLAPHAM,
'Phone : Brixton 3022 LONDON, S.W.4.

HOBBIES LTD.,
65, New Oxford Street,
Tel. Mus. 1656 LONDON, W.C.

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The twenty-nine dealers whose advertisements appear on this page carry full stocks of Meccano Outfits, Accessory Outfits and Meccano parts, Hornby Trains and Hornby Train Accessories all the year round. The names are arranged in alphabetical order of town.

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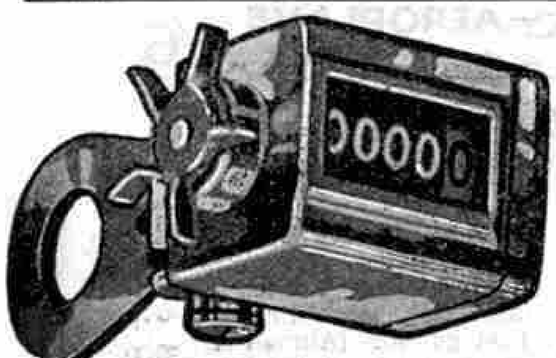
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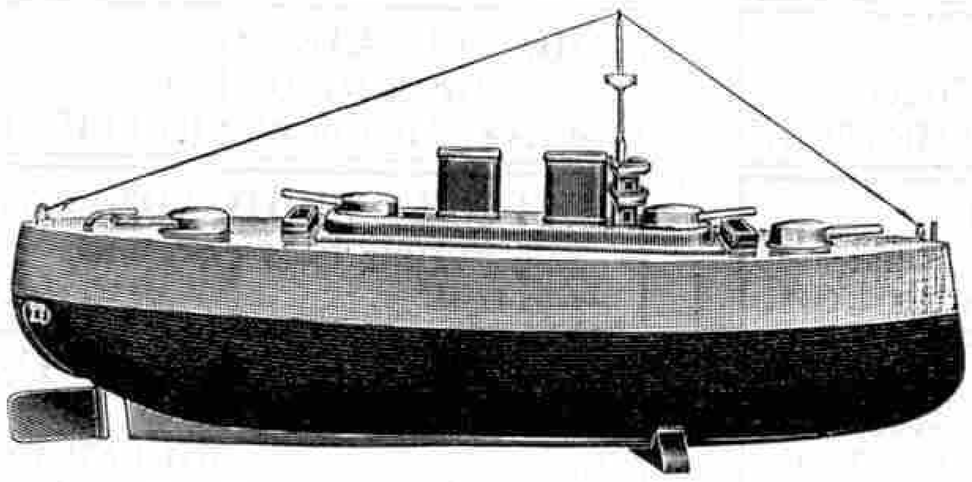
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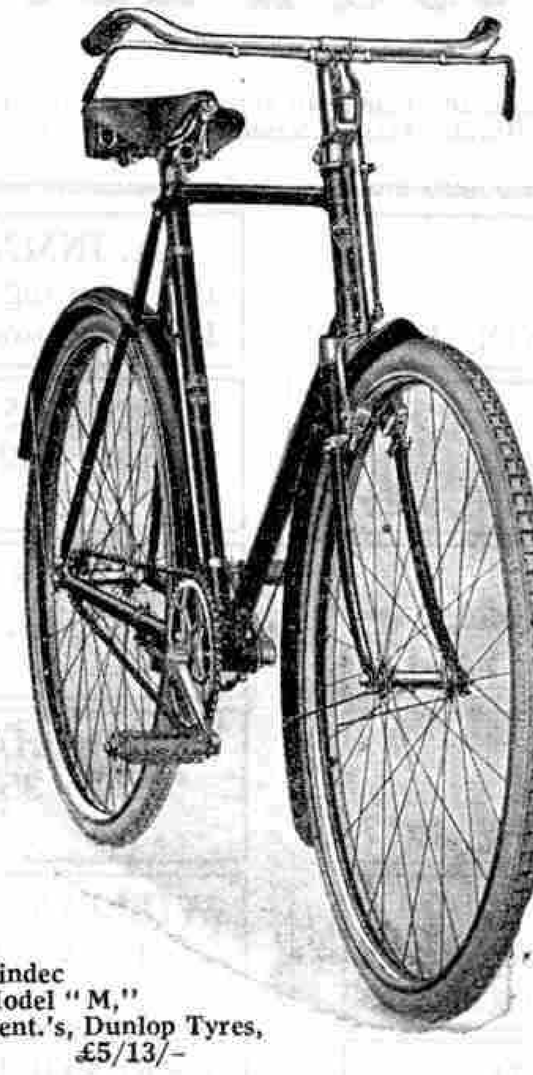


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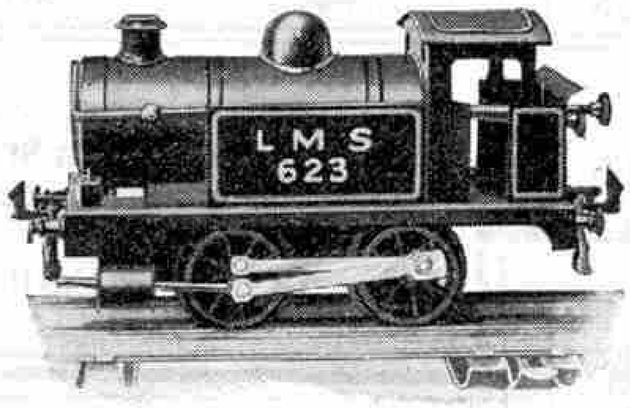
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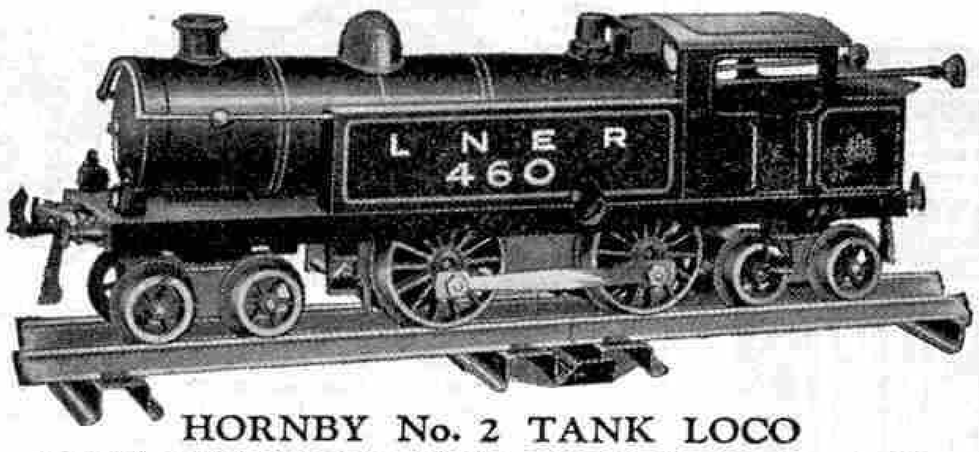
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HORNBY TANK LOCOS



HORNBY No. 1 TANK LOCO

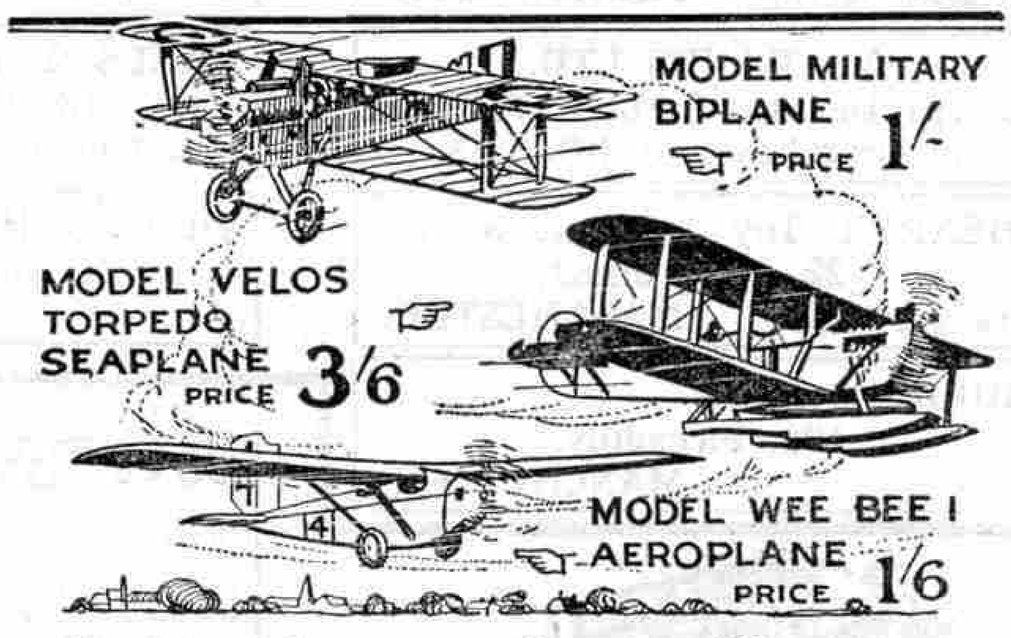
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Gauge 0, in colours to represent L.M.S., L.N.E. or G.W. Railway Companies' Locos ... ... Price **12/6**
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Powerful model embodying all the splendid Hornby characteristics. It is 10½" in length and is fitted at both ends with a four-wheeled bogey. Beautifully finished in colours to represent L.M.S., L.N.E. or G.W. Railway Companies' Locos, and suitably lettered. Fitted with reversing gear, brake and governor. Suitable for 2-ft. radius rails only. Price **22/6**
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Tom—" He says, ' S-E-C-C-O-T-I-N-E—S-T-I-C-K-S—E-V-E-R-Y-T-H-I-N-G.' "
Gwen—" Oh, the silly !—sure everybody knows that."

OF COURSE every Meccano boy who can use his hands knows all about Seccotine and what it can do but, beginning with the children, it is interesting to learn what faith other people have in the great Adhesive.

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This is not an invented story. A third adult, stranger to the others, sitting on the same seat, knew something about Seccotine and its home, and reported the incident. It is an example of the grip that Seccotine has on the national mind, that, when a child is shown something remarkable for firmness of jointing, it associates Seccotine with the good work.

King's College Chapel, Cambridge, was not built with Seccotine, but the adhesive's reliability in a wonderful variety of uses is sufficiently remarkable. It is not possible here to enumerate these uses,—mention can be made of only a few, widely differing.

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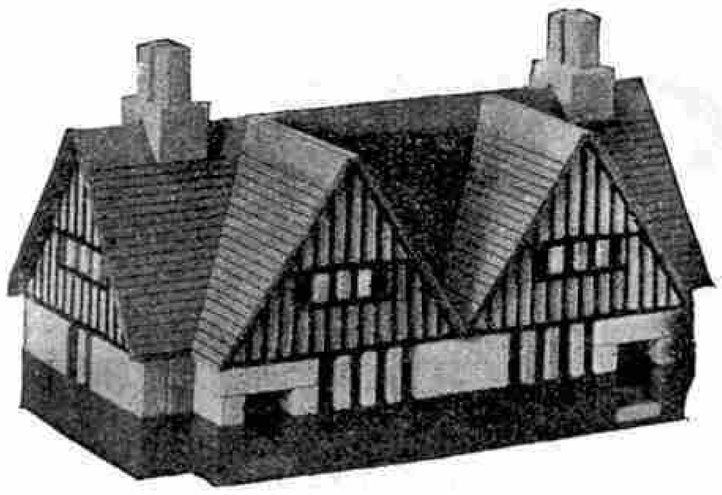
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Sticks Everything **SECCOTINE** Requires no heating

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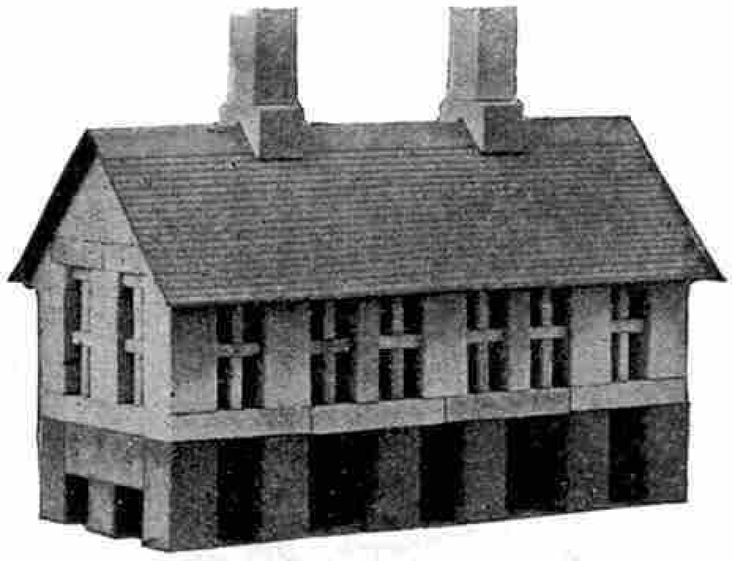
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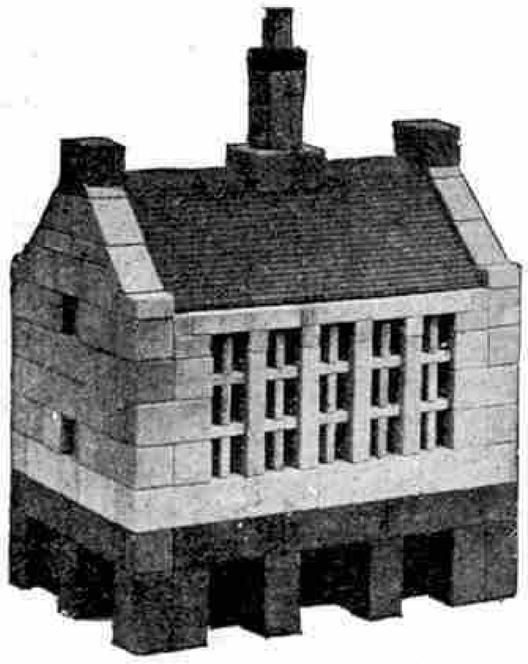


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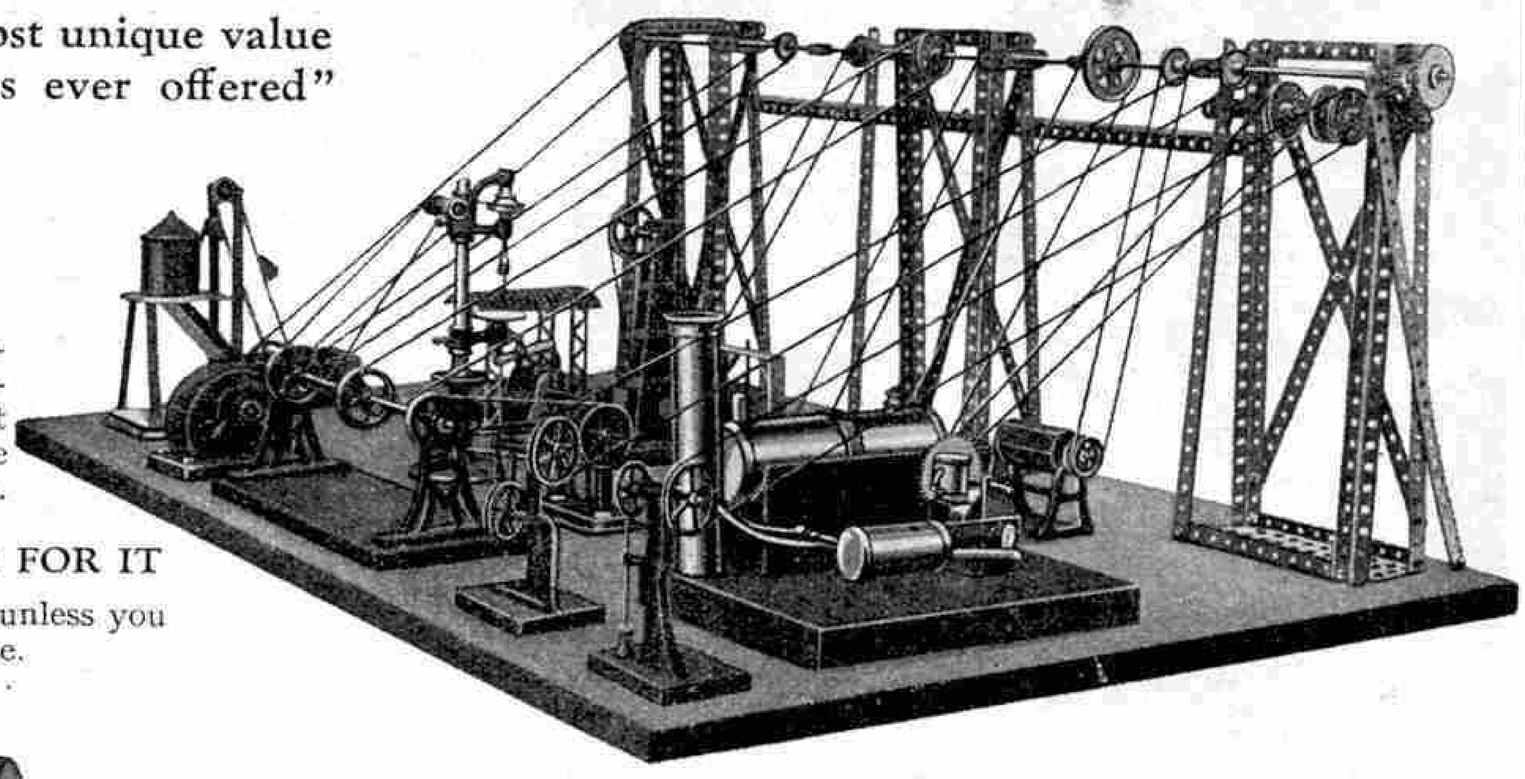


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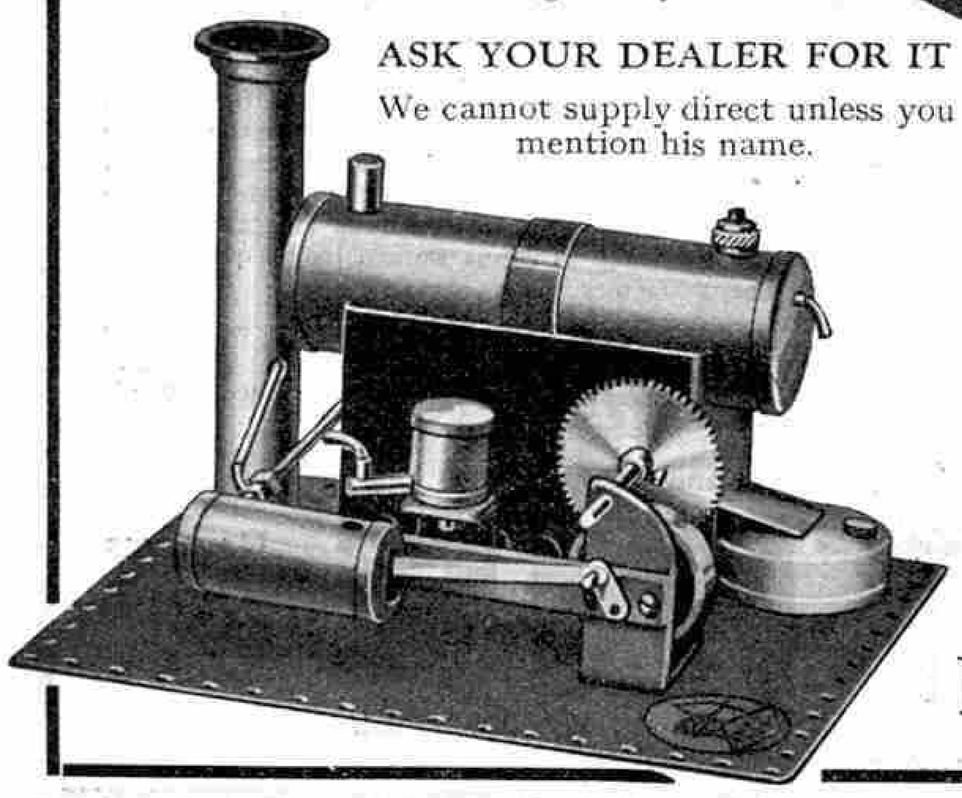
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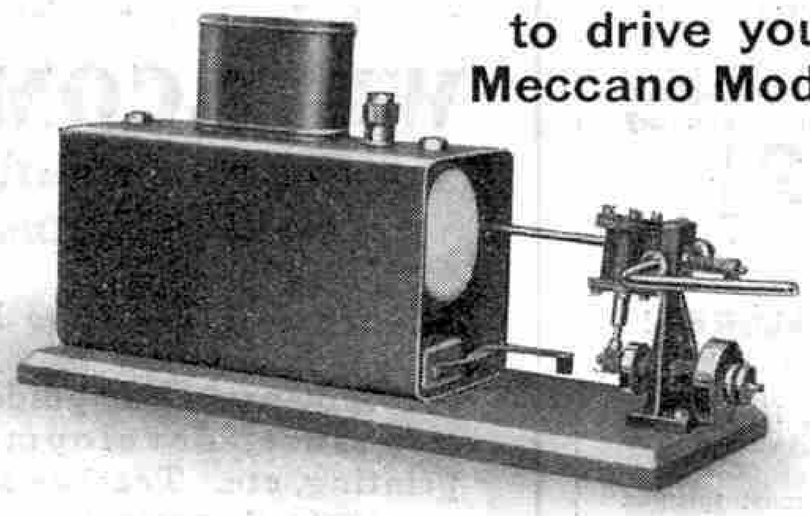
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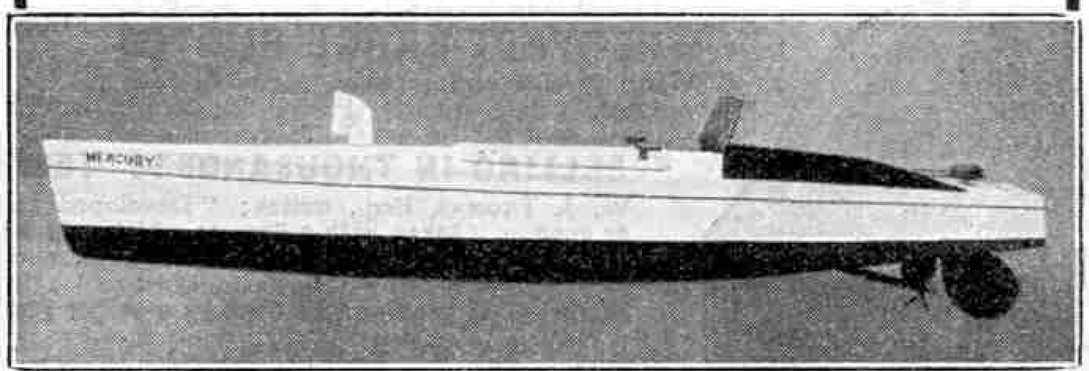
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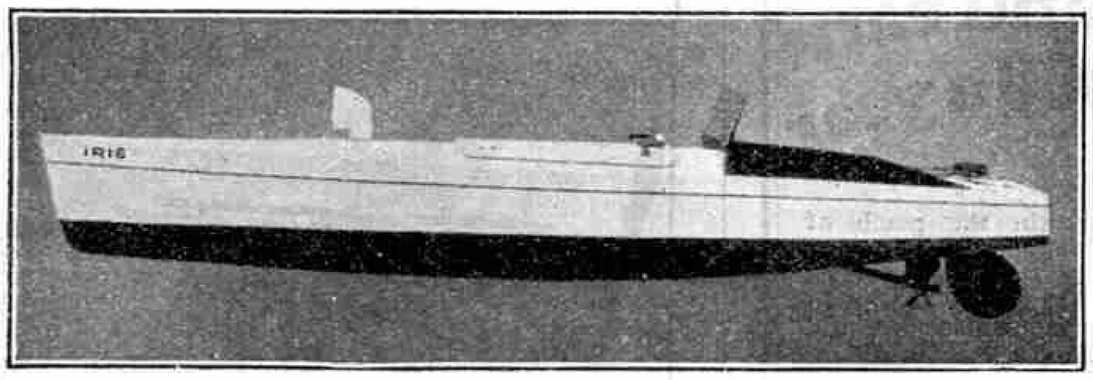
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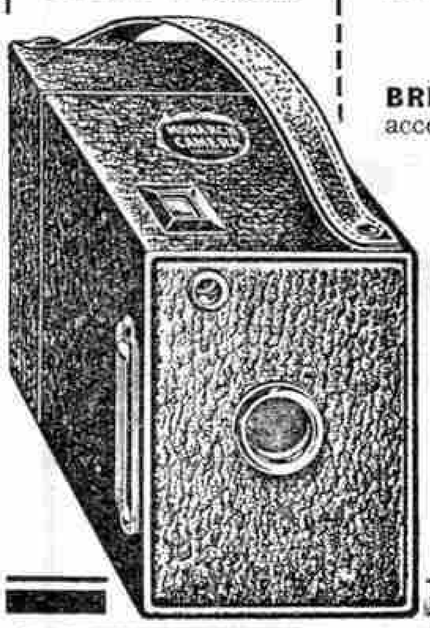
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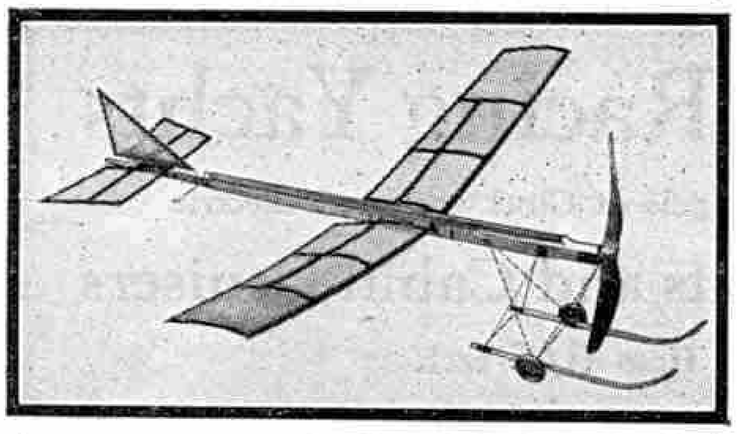
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Wing Span of our 4/6 Model 21 in., 10/6 Model 27 in. Span, with Patent Safety Chassis.

Customers write:—Your Skisail Monoplane is the best I have seen both in design and flight.—M.S.

The model has flown well and I have recommended to a friend.—J.S.

The soaring demand for our models, with letters of appreciation from happy purchasers, proves that our Patent Monoplanes still stand unrivalled. No other type can compare for **Design, Performance, or Price,** and our **Famous Patent Chassis** gives the "Skisail" a unique pre-eminence over any other make.

Purchase direct from the **Pioneer Inventors.**

Send P.O. to:—

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159, Lymington Ave., Wood Green, London, N.22.

MAKE YOUR OWN ELECTRIC LIGHT

These wonderful Dynamos light brilliantly 4-6v. lamps, and are very easy to work, **5/6**, post 6d. Delivery by return of post.

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Become a Director of Transport in 5 years and earn £300 to £1000 a year

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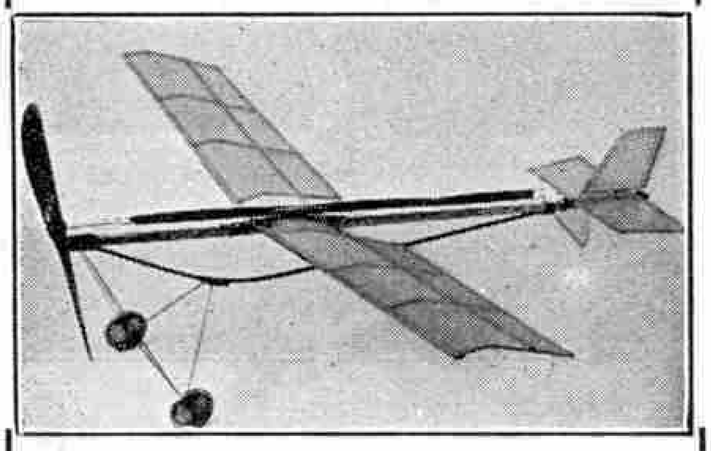
THE TRANSPORT TRAINING COLLEGE,
Dept. B,
17, Water Lane, London, E.C.3.

D. A. P.

MODEL AEROPLANES ARE THE BEST AND BRITISH

Awards, 1927

Gamage Cup for Longest Flight (Rubber Driven).
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Flight Cup. Best Performance. Auto Giro Model.
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No other make of Model Aeroplane can show such a record.
BUY THE MODEL WITH THE PROVED PERFORMANCE.



TRACTOR MONOPLANE.

No. 6 Price Span 22"
Length 24" **10/6** Flight 150 yds.

Carriage and Packing U.K. 9d. extra.

Similar machines:

No. 4b.	No. 4
Length 22"	Length 18"
Span 21"	Span 16"
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Nos. 6 and 4B fitted with Hand Carved Propeller.
These Models will rise from the ground.
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There are 101 uses for HARBUTT'S PLASTICINE

How many uses do YOU know?

This new circular of ours is of absorbing interest. You will be surprised when you read it. See if you know of a use not mentioned. We shall be glad to hear of it.

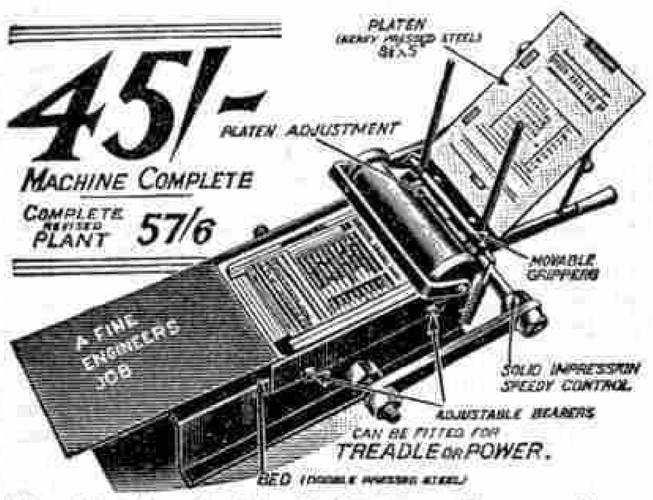
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NEW ALL-STEEL SUPER-MODEL



The Machine that is Built from the experience of over 10,000 Users of the old Model.

Over 15,000 users of Adana Printing Plants, saving enormously in their own work, and hundreds making an excellent living. Government Departments, Large Printers and Big Stores are amongst the many successful owners.

Will print any matter from

Chemist's Label to an Illustrated Magazine

at a really commercial speed, including Perforating and Creasing. Simplicity to the extreme, no special skill required. Hundreds of boys producing school magazines. Real Printers' metal type, case, all complete accessories and fully illustrated instruction book included in plant. Two-coloured illustrated particulars and samples of work sent on receipt of stamp.

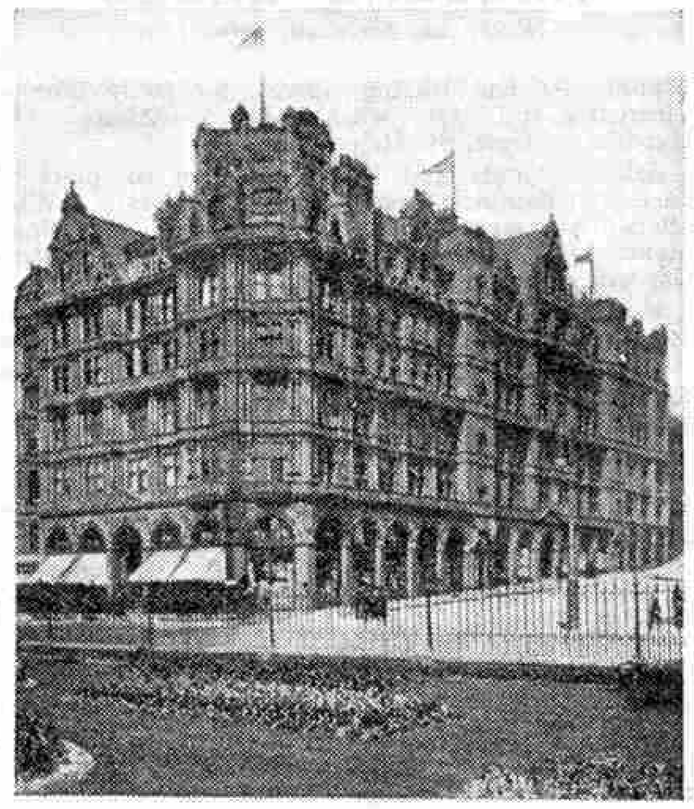
BUILT FOR COMMERCIAL USE.

Machines can be shipped abroad C.O.D. or cash against documents in London. Goods F.O.R. Twickenham.

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is a complete organization for the supply of Printing Office Equipment of every description. Controlled by most highly skilled and long experienced men of the Printing world.

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EDINBURGH AGENTS for MECCANO and Hornby Trains

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Patents for Inventions, Trade Marks : Advice Handbooks & Cons. free.—B. T. King, Regd. Patent Agent, 146a, Qn. Victoria St., London, E.C.4. 40 years' refs.

REGATTA RACING YACHTS. Before you buy your Yacht, please send for our Coloured Illustrated Price List Free. Pantoys Ltd., The Promenade, Cheltenham.

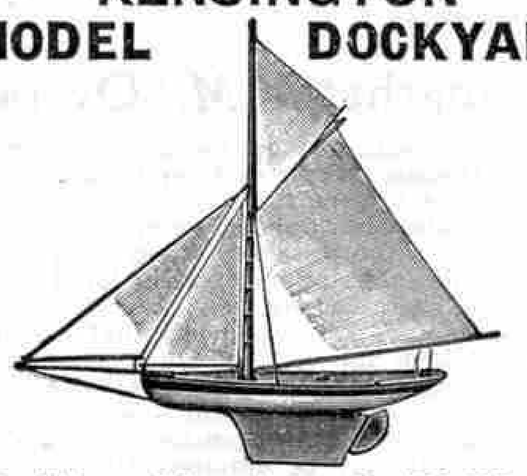
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Magnify lineally about 50 times, squares about 2,500 times. Disclose wonders of Nature invisible to naked eye. Indispensable for study of Chemistry Botany, etc. Superior Microscope' complete with tweezers, 3 objects and 3 glass slides in case, post free **5/6.** Microscope, with 3 slides in box, post free, **2/6.—R. DILNOT (Dept. M), 125, Chiswick High Road, London, W.4.**



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Sailing Yachts & Fittings

HOBBIES STEAM LAUNCHES MOTOR BOATS

Requisites for CRICKET, TENNIS, FISHING, PHOTOGRAPHY

AIR GUNS AEROPLANES

Electric Motors & Accumulators

HORNBY TRAINS

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Send 1½d. Stamp for New List "M"

C. H. LORBERG

185, Kensington High St., London, W.8

SAFETY AUTOMATIC PISTOL



11/6 each

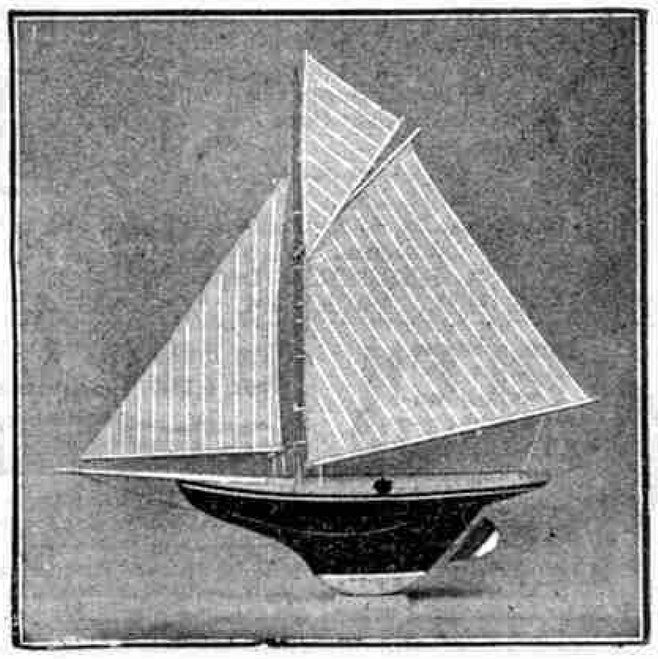
Postage 6d. extra

No License Required

Best and Simplest Safety Automatic Pistol on the market.
In appearance replica of real Automatic Pistol. In Blue Steel and Nickel (New Model).
Magazine takes six blank cartridges and after the sixth is discharged is automatically ejected for re-filling.
Useful for sports and theatricals, also great protection against burglars and foot pads.
A safeguard to motorists.

H.H. Parson (Pistol Dept.), 55, Northcote Rd., S.W.11

Four Wants for Boys





SAILING SHIPS. MOTOR BOATS. AEROPLANES. KITES.

List Post Free. Any Goods not approved, can be returned.

Goods over 6/- carriage paid, few exceptions.

C. LUCAS, Hobbies Depot

35, Manchester Street, Liverpool

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(*Rate:* 1d. *per word, min.* 1/–)

Exchange. 620 highly catalogued Stamps in Album, Set Kid Boxing Gloves, for Baby Cine or Cinematograph. Or what offers?—Atkins, 151, Hardshaw Street, St. Helens, Lancs.

Sale. "Lands and Peoples." The complete 36 parts, not bound, perfectly clean. Cost 45/–. What offers? Also set of Leather Boxing Gloves, "Spalding" make, 7/6. Bargain.—W. Turnham, 4, Greenstead Gardens, London, S.W.15.

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20 Parcels Fretwork Designs worth 5/– each, sell for 1/6 each. 900 Assorted Cigarette Cards, 6d. per 100.—BM/ZMVG, W.C.1.

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Sale (or Exchange anything useful). Meccano No. 4, Steam Engines, Stamps, Books, etc. Wanted. Camera, Dynamo, Cycle Lighting Set.—Keen, 72, Alexandra Road, Hemel Hempstead, Herts.

Sale. Mah-Jongg Set, with Instructions, as new, 10/6. Electric Motor, 8/6, or offers.—Box 501.

For Sale. Electric Table Railway. Only used half-dozen times. Perfect condition. Cost 33/–. Sell for 25/6. Also Gauge 0 Steam Engine and Rails. Also Racing Motor Boat (Clockwork) in handsome wooden box. Cost £2, sell for 30/–. Apply—Scrimgeour, Culter, Aberdeenshire.

Sale. "M.M.'s" Dec. 1924 to April 1928. Highest offer.—M. Richardson, 6, Gordon Road, West Bridgford, Nottingham.

Fine specimens Birds' Eggs. Cheap.—Fellows, The Rocks, Hurst Hill, Bilston.

Sale. Cinematograph, nearly new. First 8/– secures.—Tattam, 23, Churchyard,, Ashford, Kent.

Great Bargain. 1,000 Stamps Mounted in Album, also 2,000 Genuine Unpicked, 10/–. J. Morris, 166, Grange Road, Ilford.

Wanted. Exchange N.Z. for Canadian Indian Stamps. R. Stewart, The Lea, Balclutha, Otago, New Zealand.

Sale. Fine Leeds Model Company Locomotive, £2/19/6, new. Sale Price 36/–. In perfect condition. Apply—P. Hall, 29, Gotham St., Leicester, for particulars.

For Sale. Brownie 2 Box Camera (with Canvas Case), good condition. No. 2B Folding Camera (Kodak), accept 5/– each.—A. Barnard, St. Mark's Vicarage, Peak's Hill, Purley, Surrey.

"MECCANO MAGAZINE" BINDERS

There is no better way of keeping your Magazines clean and tidy than by binding them in one of the special binders we supply.

These binders have strong stiff backs, covered with black imitation leather, tastefully tooled, and are lettered in gold. The large binder holds 12 Magazines—price 3/6 post free. The small binder holds 6 or 8 Magazines—price 3/– post free. Meccano Ltd., Binns Road, Liverpool.

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Automatic Repeating Action. Heavy Model, Black Finish. Complete with Good Supply of Ammunition. As illustrated. Part postage 3d. **2/6**

25 Shot, heavy model, as above, 2/–
17 Shot, light model, 1/6
6 Shot, heavy model, 1/3. Postage on each, 3d extra. Colonial, 9d. extra.

A. HERBERTS (Dept. G),
27, ADYS RD., PECKHAM, LONDON, S.E.15.

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RAILWAY PHOTOGRAPHS.

Just issued, L.N.E.R. "Yorkshire" (No. 234). Send for List No. 1 of real photo postcards of Express Trains and latest Locomotives. 3d. each, or 12 different 2/2, post free.—Railway Photographs, 13, North John Street, Liverpool.

STAMP ADVERTS.

(*Continued from page* 444)

100 DIFFERENT STAMPS FREE. Send for ½d. Approvals.—Cox, 135, Cambridge Road, Seven Kings.

LOOK. Discount 5d. in 1/–. Request Approvals. Cheap.—Baxter, Windens, Marden, Kent.

BARGAIN. Stamps at ½d. and 1d. each. Apply—R.P.C., 1, Birchvale Drive, Romiley, Cheshire.

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BOOKLETS 500 Colonial and Foreign Stamps. Choose any, ½d. each. Many Bargains.—Miss Saunders, 16, Kent Road, East Molesey, Surrey.

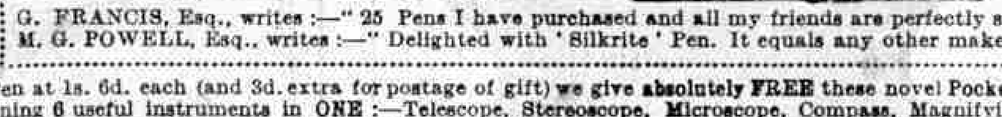
UNSORTED MISSION STAMPS.

We can offer a nice mixture of Foreign Stamps, sold exactly as imported, at about 500 for 6d., or 2,000 for 1/6. Try a lot, you'll come for more. CRANWELL, 202, Hermon Hill, London, E.18.

FREE!! GIFT



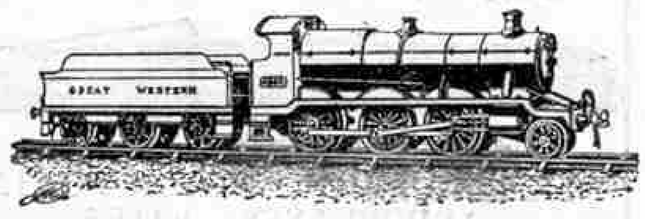
The "SILKRITE" Registered SELF-FILLING FOUNTAIN PEN
Over 5,000 Testimonials received! GUARANTEED 5 YEARS' WEAR!



1/6

G. FRANCIS, Esq., writes:—"25 Pens I have purchased and all my friends are perfectly satisfied."
M. G. POWELL, Esq., writes:—"Delighted with 'Silkrite' Pen. It equals any other make at 10s."

With every "Silkrite" Pen at 1s. 6d. each (and 3d. extra for postage of gift) we give absolutely FREE these novel Pocket Folding OPERA GLASSES combining 6 useful instruments in ONE:—Telescope, Stereoscope, Microscope, Compass, Magnifying Glass. P.O. for 1s. 9d. ONLY secures this amazing offer of Pen and Free Gift. Send NOW!! *Write for* 1928 *Gift Catalogue, Richly Illustrated, full of Big Bargains, Jewellery, Fancy Goods. Post Free!*—The LEEDS BARGAIN Co. (M), 31, Kendal Lane, LEEDS.



Our Real Scale Model of the G.W.R. "Mogul" Class Locomotive.
Gauge 0. Electric or Clockwork.

This is only one of many beautiful Models which we offer. Parts and Fittings for Home Construction a speciality.

The LEEDS MODEL Co. Ltd.,
Dept. M, BALM ROAD, HUNSLET, LEEDS.

L·M·C Accurate to Scale Perfect in Detail

NEW ENLARGED CATALOGUE
Price 1/- Post Paid,
will be advertised as soon as ready.
Full of accurate illustrations and valuable information on
MODEL RAILWAY WORK.

MECCANO MAGAZINE

Registered at G.P.O., London, for transmission by Canadian Magazine Post.

EDITORIAL AND ADVERTISING OFFICES:—
BINNS ROAD, LIVERPOOL.
Telegrams: "Meccano, Liverpool."

Publication Date. The "*M.M.*" is published on the 1st of each month and may be ordered from any Meccano dealer, or from any bookstall or newsagent, price 6d. per copy. It will be mailed direct from this office, 4/– for six issues and 8/– for twelve issues.

To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

Advertisements

Readers' Sales and Wants. Private advertisements (i.e., not trade) are charged 1d. per word, minimum 1/–. Cash with order. Editorial and Advertising matters should not be dealt with on the same sheet of paper (see important notice below).

Small Advertisements. 1/– per line (average seven words to the line), or 10/– per inch (average 12 lines to the inch). Cash with order (see important notice below).

Display. Quotations for space bookings, and latest circulation figures, will be sent on request.

Press Day, etc. Copy should be sent as early in the month as possible for insertion in following issue. We usually close for press on or before 10th of each month for following issue. Half-tone blocks up to 100 screen.

Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

Voucher Copies. Sent free to advertisers booking two inches or over. Other advertisers desiring vouchers should add 8d. to their remittance and should order voucher copy at same time.

Remittances. Postal Orders and Cheques should be made payable to Meccano Ltd.

Stamp Advertisers Please Note:—

The Readers' Sales and Wants column is reserved for advertisements dealing only with collections of stamps as a whole. A collection that is being disposed of on approval sheets, or by packets or sets, should be advertised in the small advertisement column, the rate for which is 1/– per line, average seven words to the line. Although the advertiser may not be actually conducting a stamp business, such advertisements are not to be classified under Readers' Sales and Wants.

Advertisers are asked to note that private advertisements of goods manufactured by Meccano Limited cannot be accepted.

Ordering the "*M.M.*" Overseas

Readers Overseas and in foreign countries may order the *Meccano Magazine* from regular Meccano dealers, or direct from this office. The price and subscription rates are as above, except in the case of Australia, where the price is 1/– per copy (postage extra), and the subscription rates 7/– for six months and 14/– for 12 months (post free).

Overseas readers are reminded that the prices shown throughout the "*M.M.*" are those relating to the home market. Current Overseas Price Lists of Meccano Products will be mailed free on request to any of the undermentioned agencies. Prices of other goods advertised may be obtained direct from the firms concerned.

CANADA: Meccano Ltd., 45, Colborne Street, Toronto.
AUSTRALIA: E. G. Page & Co., 52, Clarence Street, Sydney, N.S.W.
NEW ZEALAND: Models Ltd., Kingston & Federal Streets, Auckland.
SOUTH AFRICA: Arthur E. Harris (P.O. Box 1199), 142, Market Street, Johannesburg.
INDIA: Daryanamal & Bros., Elphinstone Street, Karachi. Bombay Sports Depot, Bombay. Bombay Sports Depot, Calcutta.

THE WORLD'S BEST PEA PISTOL



Not until you own a 50 Shot AUTOMATIC can you enjoy the fun of pea shooting to the full. Built on the lines of a real automatic, it is the super pea pistol. Its magazine holds 50 shots, which are fired with force and precision. Post free, **2/6**. The well-known 25 Shot Automatic, post free 2/–. The popular 17 Shot Triumph, post free, 1/2.—**R. DILNOT (Dept. M), 125, Chiswick High Road, London, W.4.**

FOR 50 YEARS!

Gamages

THE BOYS STORE

SINCE 1878!

WONDERFUL JUBILEE YEAR ATTRACTIONS

We are determined to make this a year of happy events in the history of Meccano Boys—come and visit this Great Modern Store crammed from Floor to Roof with everything boys require.

Here are but a few of the attractions !

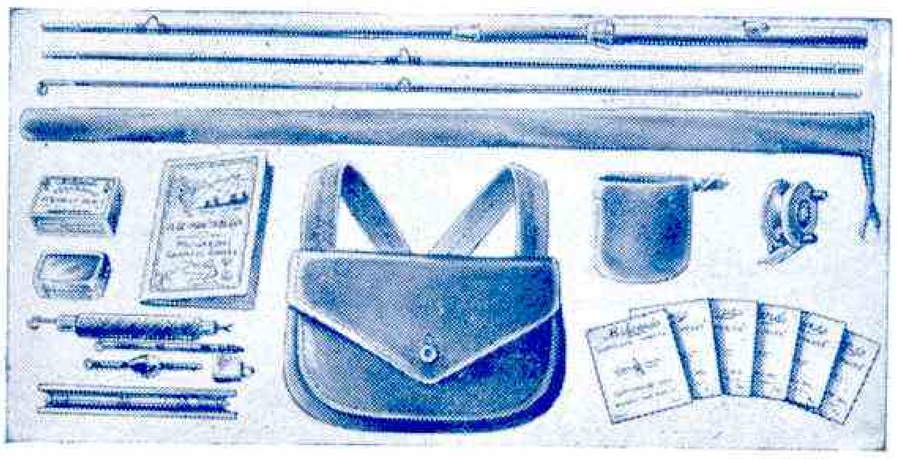
MODELS	CRICKET	THE GAMAGE ZOO
RADIO	CONJURING	FISHING
BICYCLES	CHEMISTRY	CAMPING

Etc.



CRICKETERS LOOK!

The Yorkshire Driver Bat, Rubber and Cane Handles, Selected Blades, No. 6	11/6
The A.W.G. No. 6 A Splendid Bat for the money	9/6
Strong White Canvas Leg Guards, per pair	7/6
The Famous "Club" Cricket Ball, 4¾ oz. ...	8/6
White Buck Batting Gloves, per pair... ...	10/6
Full Size Club Bag ...	11/6
Grey Flannel Trousers ...	7/11
White Flannel Trousers	10/6
Blue Blazers	15/6
White Cricket Shirts ...	4/11
Strong Cricket Boots	12/9



TAKE UP ANGLING

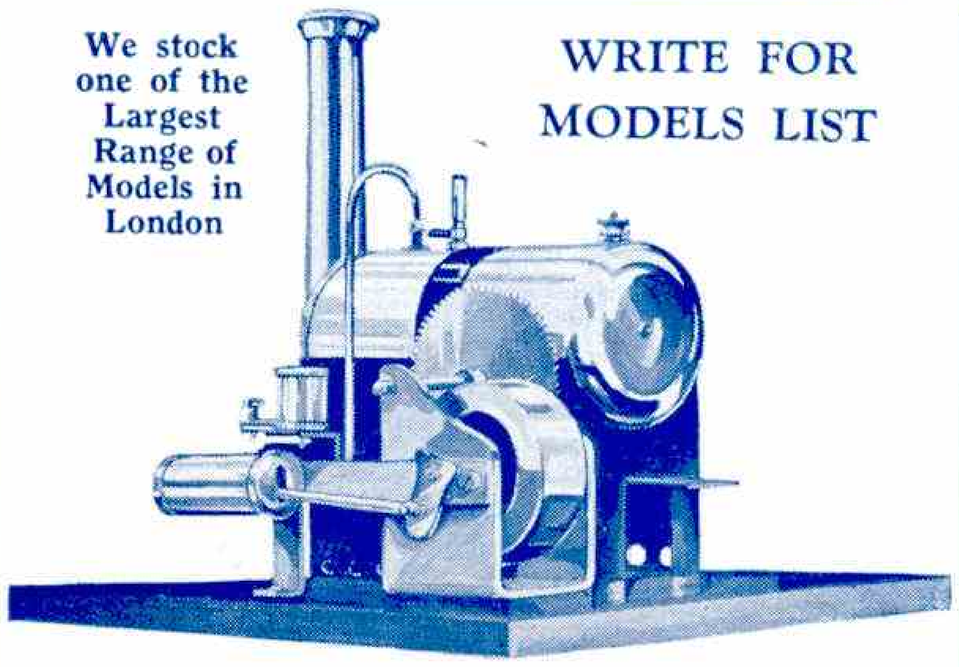
Gamages Complete Fishing Outfit

Fishing's a splendid sport with the set illustrated above. Complete in box. Each box contains 8 ft. 3 joint rod with rings and reel fittings. Reel, Lines, Floats, Gut Casts, Ledger, 7 Hooks to Gut, Plummet, Split Shot, Disgorger, Haversack, Worm Bag, Bait, and Book on "How to Begin."

Price complete **21/-**

We stock one of the Largest Range of Models in London

WRITE FOR MODELS LIST



GET THIS FAMOUS MODEL HORIZONTAL ENGINE

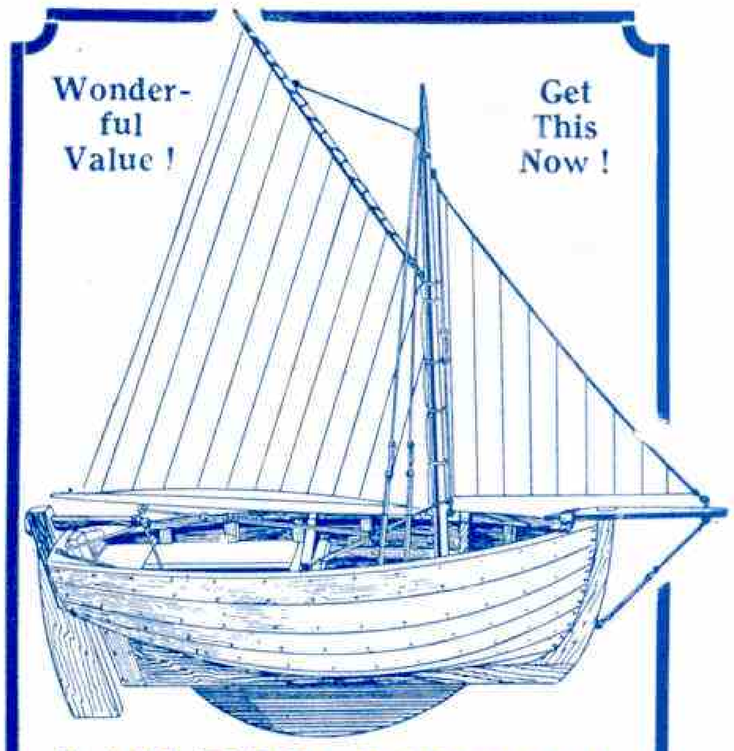
Solid Brass and Steel throughout, Two-Speed Gear, Automatic Drip Feed Lubrication, Overflow Tap for filling to correct level, absolute safety secured by the new non-sticking Safety Valve. This Engine drove a Meccano Big Wheel, 30 in. high at the British Industries Fair.

32/6

Runs for 1½ hours with one filling.

IT DRIVES { Any Meccano model with ease. A small 4-volt dynamo. A large number of small models. Several Hobbies fretwork models. A crane lifting 8 lbs. direct weight. Sewing Machine.

Wonderful Value ! Get This Now !

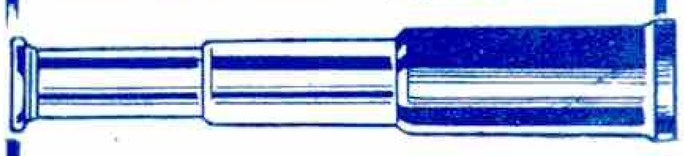


SAILING DINGHY

BUILT TO SCALE

Strongly made, beautifully finished, fitted with rigging and sails, adjustments are very easy, strong wooden hull. Price, Size 20 ins. 22 ins., **52/6** 24 ins. **62/6**

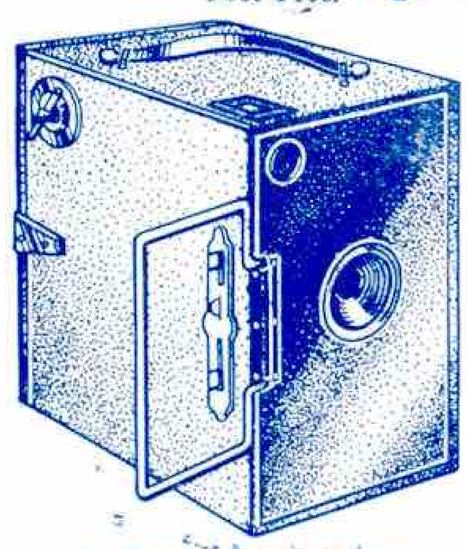
45/-



Powerful Telescopes!

These are first-class instruments. Of very convenient size, very strong. Powerful. Dimensions extended 6 ins. Closed 3 ins. Nickelled 2 draw Tubes, Black Japanned Body. Post Free.

5/6



A Great Bargain in Roll Film Cameras

Daylight Loading Roll Film Cameras. A good class Camera at an inexpensive price. Every boy should possess one of these. Photography is a fine hobby and cheap too with these. Films, any Standard Make, 1/2 per spool of 6. Price

4/6

WE STOCK ALL HORNBY TRAINS AND MECCANO PARTS

A. W. GAMAGE LTD., HOLBORN, LONDON, E.C. 1

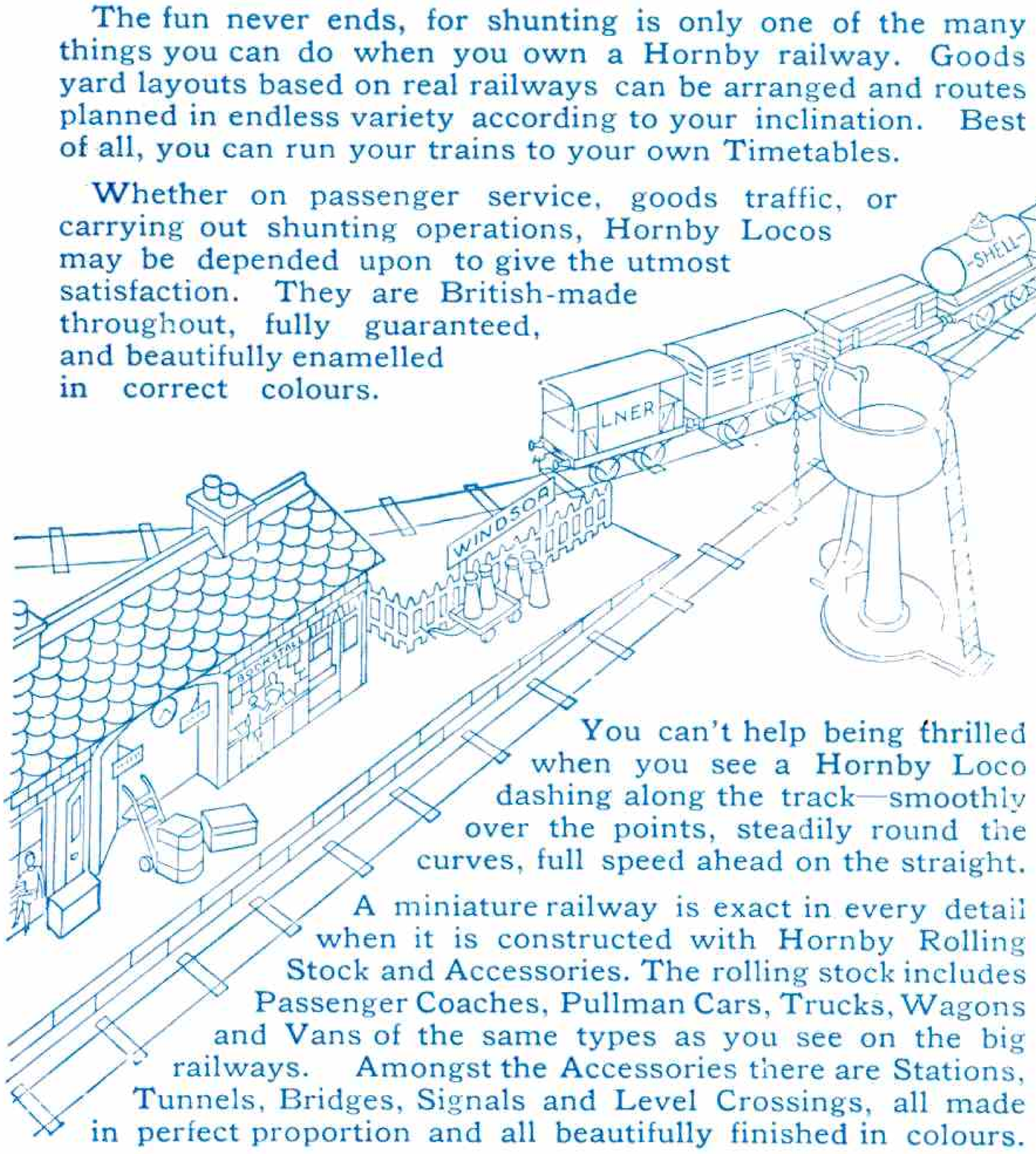
BRITISH AND GUARANTEED

Shunting with a Hornby Train is fine fun—

Watch a real locomotive shunting at the station. Then, when you get home, carry out similar operations with your Hornby railway. It's fine fun and just like the real thing.

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